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CONTENTS

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No. 1. January 1921.

No. 2. February 1921.

The Geographical Journal

Vol. LVII No. 1 January 1921

MOUNT EVEREST

Brig.-General the Hon. C. G. Bruce

Read at the Meeting of the Society, 8 *November* 1920.

I DO not think that the exploration and attempted ascent of Mount Everest have ever before formed the exclusive subject of a paper at the Royal Geographical Society. This does not mean that the Society has never before interested itself in the Mount Everest group as a possible field for exploration—very much the opposite—but that never before has its exploration on a great scale been seriously taken in hand. It is probably known to all here that an ascent of Mount Everest and the exploration of the northern slopes of its massif, form the object, probably, and with luck, of the next great undertaking of this Society.

The history of all previous attempts to explore this region has been disappointing to its promoters. Political difficulties on each occasion have stood in the way.

It is necessary to give a short account of previous attempts. I believe the very first time such an expedition was mooted was in the following circumstances: but I must of course point out that I do not now refer to the immense attention which had before, and has since, been paid to the great mountain, its measurements, the arguments over its name, and its visibility from different localities; I refer strictly to proposals to get on to the mountain itself, and on to its satellites.

In 1893 I took part in a mission which was sent to Chitral from the Gilgit agency, to place a new ruler on the throne of that turbulent state. The mission was under the leadership of Sir George Scott Robertson, the explorer of Kafiristan, and later the defender of the Chitral fort. Its second in command was Sir Francis Younghusband. I had lately joined the Gilgit agency as Special Service Officer from Sir Martin Conway's expedition to the Karakoram. We talked over numerous projects, the most favoured and most sporting being an attempt to reach Lhasa *viâ* the headwaters of the Yarkand River, under the leadership of Sir George Scott Robinson and Macartney from Kashgar.

The second proposal was one that particularly appealed to myself, and I think also to Sir Francis—the Everest group. It is a far cry from Chitral to Eastern Nepal and the Tingri Maidan, but had not Sir Francis

himself come all the way from China through the howling Gobi Desert and over the Mustagh Pass in the Karakoram to boot? What is distance, anyhow? I think we finally attached our Everest expedition as a fitting end to the Lhasa expedition, but am not quite sure on this point. At any rate, after sympathetic letters had passed from Simla, all our plans were stopped for the usual political reasons. Subsequent exciting times on the Frontier and the exigencies of the service separated the leader and his humble and junior assistant.

Before the next proposal for an expedition was made there was a very big gap—no less than from 1893 to 1907—and in the interval the Tibetan expedition had taken place; Lhasa had been reached by British troops; and Colonel Ryder's and Major Rawling's magnificent journey up the Brahmaputra had been made. Our knowledge of the north side of the Himalayas had been vastly increased. Of course, this expedition is inseparably connected with the name of Sir Francis Younghusband. Curiously enough I found myself in Chitral again at that very time, and I think the President will remember an urgent appeal from Chitral to join him. I actually received an answer that I was too far off.

The next attempt was mooted in 1906. In that year I was at home, and suggested to Mr. Mumm one evening when we met at the Alpine Club that he should really come out to India and see the Himalaya. If the Himalaya, why not Everest? Dr. Longstaff was approached, but I fancy the idea had already attracted him, although at that time he was mightily occupied with his favourite Garhwal. We soon formed ourselves into a committee of three, and elected each other as the sole members of this expedition. I must say that it would have been entirely due to the generosity of my companions that the expedition was rendered possible.

We then naturally approached the Geographical Society, and were in every way most enthusiastically treated by Sir George Goldie, the then President. Not only did the Society make us a liberal grant, but the President took infinite personal trouble to obtain for us the sanction of the Secretary of State for India. From the Government of India itself we also received every encouragement, and were informed that if we could obtain the sanction of the Home Government, the Government of India was prepared to assist us in every way. There is no doubt that we could have counted on assistance for supplies from the Nepalese Government, although at that time it would have been impossible to have proposed passage through Nepal territory.

Our project was precisely the same as that now proposed, and I will roughly indicate it: to cross into Tibet to Kampa Dzong, and then proceed *viâ* the Tingri Maidan to the north of the Everest group, and thence make our attempt to climb Everest by the northern slopes. We should probably not have succeeded, but we should have gained experience which would have been of value to subsequent expeditions. This route has now been clearly shown to be the most convenient, for it must be

remembered that we then wished, and now hope, to establish a base as high as possible, and as near as possible to Everest itself, and that that camp should be replete with every mountaineering comfort. After all the route to it is but 120 miles from Kampa Dzong, and our main interest should be the avoiding of all unnecessary exertion and difficulty until that camp is established. After that time the intensely interesting country, including the gorge of the Arun River, and mountains east and west of Everest could, I hope, also be explored.

We had certain advantages. We had engaged the two Brocherel brothers, than whom no better guides have ever travelled abroad. They had both been with Dr. Longstaff in Garhwal and Tibet, and had undoubtedly with him reached 24,000 feet on Gurla Mandhata, which, if they had had facilities for measurement, would in all probablity at that time, and until the date of the Abruzzi Karakoram expedition, have been the highest point attained, its only rival being the unproved but probably correct ascent of Kabru by Graham. We also had a good train of Gurkhas already ear-marked. What we had not understood, however, was the necessity for a full preliminary exploration, which is now amply made clear.

It was not to be, however. Lord Morley, the then Secretary of State, was averse to our entering Tibet at all, as being contrary to the lately completed treaty with Russia.

Owing to the kindness of Lord Minto, this expedition was directed to British Garhwal, and resulted, among other things, in the climbing of Trissul by Dr. Longstaff, the two Brocherels, and Subadar Karbir Burathoki (5th Gurkhas).

In the following winter I found myself the guest of Colonel Manners-Smith, the Resident in Nepal, and had several talks with the Maharajah, the Prime Minister and Marshal of Nepal, who was very much interested in our last attempt, and, after much talk, himself proposed a joint Anglo–Nepalese expedition, which should enter Nepal *viâ* Hanuman Nagar and march *viâ* the valley of the Dudh Kosi. Naturally I was overjoyed, and, with the assistance of Colonel Manners-Smith, approached the Government of India on the subject. Correspondence ensued.

I must mention that previous to this the Nepalese Government had given leave to the Government of India to send a surveyor of the Survey Department to explore the upper Dudh Kosi, and, I believe, determine if possible whether Mount Everest was actually in Nepalese or Tibetan territory. This is still a doubtful point. But the two passes, the Pangu La and the Popti La, respectively 20 miles west and east of the mountains, are claimed by the Nepalese. Beyond that, the report of his explorations would have been of the very greatest assistance.

I must mention that Maharajah Sir Chandra Shamsher Jang, the Prime Minister, though by far the greatest force in Nepal, is not an autocrat, and that he has to be just as careful of public opinion as any

one else in a similar position. The result was that, as my preparations proceeded, so was the scope of the expedition cut down, until I was finally reduced to a three months' rush across the frontier, and a maximum of twelve coolies. My original proposals had naturally been for a sufficient though, knowing what to expect, not an ample outfit. I promptly accepted, hoping to get at least a photographic record of the greatest interest, but seeing that I was not to be put off, a final telegram came saying that the expedition was unadvisable.

Public opinion in Nepal means that of the Kshettriya nobles, and cannot be despised; and even though the Maharajah himself was in favour of it, it would have been quite impossible for him to have gone against the ingrained prejudices of his Darbar; of that I am certain. But so long had been the negotiations, and so many times had I cut down my requirements, and yet so near was the date for my start, that I was actually waiting with my modest camp packed when the final telegram arrived. An outlet was required, so I cut down something else, to wit my leave, could take only a month, and hastened to Jongri in Sikkim at express speed in the vain hope of seeing some of the glaciers that descend from Kabru and Janu. But my luck was out that year, and not for a moment did the mist lift or the snow and sleet stop.

Our present proposal is based on the same plan as that of the 1907 project, but we intend to go much more thoroughly into it. It is hoped to make a thorough reconnaissance of the upper Tingri Maidan and of the country surrounding the northern slopes of Everest. There are certain ridges to be crossed. The upper course of the Arun River must also be crossed, and our whole outfit and main base established as near the great mountain massif as is possible. We also have to organize our transport, both men and animals, and it is hoped to train a team of porters for the exploration of the upper snows. In some ways the country enjoys a great advantage, in that it is in all probability not too difficult for yaks. We hope by their help to carry our main camp, or from the main camp to push higher ones, to over 20,000 feet, from which point we must depend on men; and that is one of our most serious difficulties.

We hope to be able to sufficiently interest the Government of India, so that they will place aeroplanes for reconnaissance at our disposal. Whether it would be possible for aeroplanes to land safely, and having landed, to rise again, must be left by me for experts to decide. Naturally, if this could be done our whole arrangements would be simplified mightily.

I am pretty certain that Nepal would be willing to help us by sending grain and food, either over the Popti La, or the Pangu La, or up the Arun River. Before they could arrive we should have to make very careful arrangements for meeting them. There are however known passes into Tibet through the Nepal Himalaya, and therefore no great

SKETCH-MAP OF THE NEIGHBOURHOOD OF MOUNT EVEREST

MOUNT EVEREST FROM SANDAKPHU, 16 MILES WEST OF DARJEELING

Tele-Phot. by Mr. J. Burlington Smith, Darjeeling

difficulty should be experienced in communicating with them, especially with the help of an aeroplane service. The whole of these questions will be gone into thoroughly, and tested during the preliminary reconnaissance.

It does not by any means follow that during the reconnaissance ways and means of approach, camping grounds, aeroplane service, landing grounds, establishment of depôts, etc., will be the only work to be done. We must also thoroughly train and test our teams, and we must also test our men. As much as possible of the lower slopes of Mount Everest itself should be thoroughly explored, and also, if possible, the final line of advance actually determined. We should see how far we could expect to push our camps. We have a good deal to go into in all this, but not too much by any means. We know that in not too difficult ground sufficient equipment can be carried to 22,000 feet, because it has been done more than once; but against that we know that on the Duke of the Abruzzi's highest climb the pace of a very strong party, to wit that of the hardiest Italian guides, and the Duke himself, was near 250 feet per hour. We want to push camps to at least 25,000 feet, or higher, if possible. Now no one can say that the Duke's party was overworked. It was a splendidly fitted out expedition with ample means, and therefore with ample porterage and the best of food—two most necessary conditions if great things are to be done well. Therefore the members were not worn with much preliminary toil, but should have been at their best when the final test came. Yet we see how slow their progress was. His actual rates were as follows: from 23,000 to 23,450 the rate was 396; between 23,450 and 24,250 it was 273; and the last stretch to 24,600 was at the rate of 160 feet per hour.

Our task is to put camps higher than the highest already attained by unladen men, and to produce our climbing party at the top of its form at these camps, and it is for this reason that we must take the greatest care to have adequate carrying power, well clothed, fed, and trained.

When one looks at the north ridge of Mount Everest, it appears not too steep, but one must also take into consideration the climate of Tibet. Sir Francis Younghusband tells me that in the height of the monsoon season the northern face was nearly always clear. The climate of Tibet is notoriously dry, and the sun notoriously strong. The result of that combination is that the face will almost certainly be largely ice. It will be very lucky if it is not so. That will be a very great difficulty, as ice invariably means hard work, and that is the one thing we do not want. What we want is continual fine weather and firm snow. Our other great danger is too much wind; that also may possibly be a serious difficulty.

One of the most important tasks for the reconnoitring party to undertake will, of course, be to find the easiest way which leads from Kampa Dzong and over the Tingri to the foot of Everest. We are not quite clear how far to the north the great gorge of the Arun river extends, but we

do not want to be involved in the hard work of crossing high ridges and descents, when probably by travelling further to the north we could advance on much easier ground direct to our objective. From the map we now have it seems, as if to avoid the ridges it will be necessary to pass well to the north, and the easier our route is, the longer we shall be able to do without man carriage and to employ our yaks. It might even be worth while to carry a certain amount of fodder for the yaks, if the scanty herbage on which they seem to thrive gives out, and if the ground is still possible for them. Naturally, having pushed our yaks to the greatest extent, a base would be formed and the yaks would return to feed, and to get into condition again for further efforts, or to return for further supplies.

In order to make the most of our British climbers, we must have, as I have said before, a properly trained team of porters. This is a very important part of the expedition, and therefore it would be well to review the subject of Himalayan porters in general and the work that they have done for numerous expeditions. Almost always one finds, on reading accounts of Himalayan travel, that difficulties have arisen over the coolies. Some well-known explorers have apparently met continuous difficulty. One exploring party invariably has done so, and I am afraid not without reason. Here is an extract from one of their works which speaks for itself. "We were told that as the natives had been starved for two and a half years they were anxious for work; but this does not appear to be the spirit at all." Starvation certainly does seem an excellent preparation for about the hardest work a human being can do.

Naturally, if the Himalayan is to be explored at all, assistance must be given in obtaining porters. The result is that every able-bodied man from the local villages is usually roped in by the civil authorities, and more or less obliged to go, nearly always against his will, certainly against the will of the majority, to carry loads up into the snows at a stated and quite inadequate remuneration, for a more or less protracted period, according to the locality. If, however, the traveller confines himself to well-known passes, and holds out hopes that his men will be back home in a few days, and, above all, if he requires few men, there is usually very little difficulty in obtaining sufficient, especially for non-ambitious journeys.

I will give an illustration of what I mean. The village of Askoley in Baltistan, which is the last village in the direction of the Biafo, Punmah, and Baltoro glaciers, is emptied by every explorer in succession completely, and usually the villages a little lower down as well. Eighty per cent. of the inhabitants loathe going on to the ice. They are indifferently clothed, have to live over-hard, even for them, and if there is bad weather have a miserable time; there is naturally no incentive that they would care twopence about. Naturally they do everything possible to lighten their work and get away. Mr. Montagnier of the Alpine Club gave me

an amusing account of his arrival in 1903 or 1904. The whole village took to the hill on his arrival, and refused to come down, and from this elevated spot showered stones and abuse on him and his emissaries. "Here is another infernal traveller on his way to the ice."

The Balti is a hardy, very simple, but a rather low-couraged and depressed specimen of humanity. For their trouble they have received very little besides abuse from any one. But it is really wonderful what has been got out of them. Dr. Guillarmod, in his excellent book on his exploration of K_2, states that his Balti coolies served him well, although many of them were barefooted; they made boots out of raw sheepskins for glacier work. He apparently had little difficulty during the five to six months that he employed them.

It has been the same all through. The porter difficulty has required right handling. When their employers have done their own obvious duty by their coolies the men have played up in a wonderful way, and, considering that they have little interest and small reward, have often shown themselves good sportsmen. But the view that on a climber's arrival in a Himalayan village, all the young men, most of the old, and some of the boys, will shout, "Hurrah! here's another chance of sleeping on the ice and eating chupatties a week old," should be eliminated.

With regard to the resistance of Himalayans to cold, the average can stand greater exposure with his scanty clothing than the average European under the same conditions of clothing. Tibetans undoubtedly can. But great cold, night after night, reduces condition and vitality, and we are out to produce our carrying train at great heights at the top of their form.

May I quote an extract from a book I wrote on Himalayan travel to show my views on the subject?

"We had our special outfits, the best of clothing, sleeping-bags, thermos bottles, and boots and light tents, and even then we all suffered considerably from cold. How could the wretchedly clad local man be expected to lie out at 18,000 feet in the snow on May the 20th, and, even if he survived, be worth anything the next day? I have on many occasions seen natives sleep in the snow with the one blanket that they carried with them as their only coverlet, but not at such a height nor so early in the year. I have also been on expeditions in which our numerous coolies slept packed together in a tent with no more cover, and lived on the lightest food; but such exposure would take it out of the strongest and best-nourished man. I believe there have been several criticisms on the local men by Europeans and other travellers, who have been hurt and disappointed because the natives failed them after several days of this sort of thing, 'although,' as they said, 'we provided them with tents.' In fact, when I creep into my Mummery tent and take my boots off and pull on a pair of special long sleeping-socks over my dry stockings, and put on a dry shirt and pull down my Balaclava cap, and then creep into my swan's-down sleeping-bag and finally have a nice hot pull out of my

thermos bottle, I have often wondered myself why the coolies should complain of feeling unwell in the morning."

Properly treated, real good men can be got anywhere, and, if we take the trouble, no better than from Eastern Nepal and Sikkim; but it must be made worth their while. Good men must be got, well clothed, well fed and trained, and above all made to take an interest in the proceedings. It must be thoroughly understood that invariably the local superstition about the mountains will play its part. I have had it said to me on several occasions that Kangchenjunga always claims his man, and that after that its explorers are all right and are safe enough. Kangchen naturally has its especial god. You can see pictures of him in any Sikkim monastery.

Now I have travelled with every conceivable porter in the Himalaya and Hindu Kush, from Kalash Kafirs to Tibetans, and I must place first of all Hunza-Nagaris and Kanjutis, and Tibetans of whatever class I have employed, Sher Pas especially, for high expeditions; but I have had excellent experiences with many other types as well. If one gets the right men, and above all gets their confidence, one can get together splendid teams of carriers in almost any part of the Himalaya, but one must accept them as one finds them, and not expect them to immediately fall in with one's own views about everything. They will try one's patience, that is a certainty. Their food arrangements will come at the wrong time, and irritate. All sorts of things will irritate, and will have to be borne philosophically.

Now what we want is a full team of specially picked Tibetans or Bhotias. I am all for getting a team of Sher Pa Bhotias. The Sher Pa is usually a Nepalese subject, and inhabits largely the high southern slopes of the Himalaya; there are many of them settled in Sikkim, and numbers working in Darjeeling. The advantage of the Sher Pa is that one has a greater hold over him than over the other Bhotias, with the exception of the Sikkim Bhotia, the Deng Jung; and I have always found him a sportsman. Many speak usually their own Tibetan dialect, and Nepali and Hindustani occasionally. These men should be directly in charge of their own sardars, but should have besides two or three young Gurkhas, N.C.O.'s of our Gurkha regiments, who would really be in charge of them. These N.C.O.'s should be of certain particular classes, besides being specially chosen for physique and cheerful dispositions. They should belong to the Low Church Party, not the High Church. I know at this moment three or four who would do admirably.

The Sher Pa team should be well clothed and booted, and among their duties the N.C.O.'s would have to interest them in the objects of the expedition, and awake an *esprit de corps*. The men must come back from their reconnaissance the first year, ready and willing to return and complete their work, and feeling keen and anxious to meet again the

members of the expedition, part and parcel of which they must feel themselves.

I know this can be done, and I give you one instance. In 1909, when I went to Jongri, nearly all my men were those who had been employed by Messrs. Rubenson and Monrad Aas. Now although we had awful weather and continual discomfort, these men were as keen as possible, and kept on urging me to go on; they said they were quite ready at any time to go up into the Himal. They were almost without exception Sher Pas, and came from the upper waters of the Dudh Kosi. All this speaks well for their previous experiences with Messrs. Monrad Aas and Rubenson.

Here is another way in which the Nepal Government could undoubtedly help. If we found difficulty in Darjeeling itself or from Sikkim in getting suitable men, they would probably be able to find us, and possibly pick for us themselves, a limited number of known good men. We must be liberal, however, in terms and outfit. After all, we don't want a very big team. The fewer permanent men we can get on with the better.

Take another instance, Dr. Kellas' Bhotias. No one could speak more highly of his companions than he does, and further he gives them credit for wonderful powers at high altitudes. He states that his coolies above a certain height, 22,000 feet, even with light loads, were 30 per cent. better than himself even without any load at all. Now these coolies were often obliged to put up with very short commons of indifferent food, and yet they stood the cold down to 29 degrees below zero Cent. without harm. I wonder how many times they have come back to him. Not only did they travel with him in their own country, but the only time I met him, on his way to Nanga Parbat, which lies on the Indus in the Gilgit agency, and is, as every one probably knows, the actual western extremity of the Himalaya proper, they were with him then, very very far from their own country. Now Dr. Kellas does not travel luxuriously, and he makes his men work, and work mighty hard. But he does it correctly, and his especial men he develops in a wonderful way.

We have greater attractions to offer, and bigger aims, and if during the reconnaissance our carrying team is well run, when called upon for the actual attempt it should be more than willing, well-trained, and reliable; and we should ourselves feel that at any rate we shall be able to establish and ration camps as high as it is humanly possible to place them. Looking back over the record of the greatest heights at which climbers have had camps established, we find that on a few occasions camps have been carried to over 22,000 feet.

Having now more or less disposed of one of the important elements of the expedition, let me proceed to examine the chances that the climbers will have of actually reaching the summit of the great mountain itself. We really know very little of its geography. We have a distant picture

of its northern ridge, far the most promising part of the mountain that has yet been seen. It however causes one to think; there are evidently portions of it which are steep, and we have to think out our camps. Very much will depend on what that ridge usually is. Will it be ice, or firm snow, or soft snow? This last is terrible at great heights. It is what stopped the Duke of the Abruzzi.

Let us review what has already been done. First and foremost, as being in my opinion the feat of the greatest endurance that has yet been accomplished, and which leaves us full of hopes: not the climb of the Duke of the Abruzzi, but Dr. Longstaff's attempt at Gurla Mandhata in 1905. To begin with, I am convinced that 24,000 feet was to all intents and purposes reached, and may have been passed. The height of the mountain is probably 25,850 feet. They had had a week or more of the hardest work, during which they had twice reached at least a height of 22,000 feet, the last time carrying their own camp to at least 20,000 feet themselves. On the day when they made their final attempt they got on to some treacherous snow which gave way and carried them down in a great avalanche for 1500 feet, successfully jumping two small cliffs. Finally, by a supreme exertion of strength on the part of one of the Brocherels, they managed to extricate themselves. After a little time, having recovered, they proceeded with their attempt, and found a better route, spending a night in a hole in the snow with a minimum of food and naturally no extra clothing. They continued the ascent next morning, and only owing to extreme fatigue and to headache, induced by the loss of at least two hats, were then compelled to give up, having, according to their rather modest computation, reached to within 1500 feet of the summit, and hit on the exactly correct route.

Now this is not the right way to prepare one's self to conquer a great peak. I am certain that, if they had been fresh, had had ample time and provisions, instead of having to travel hard to catch up their main camp, they would have succeeded in reaching the actual summit of Gurla Mandhata, and have established a record which would have remained to the present time.

As a matter of fact Dr. Longstaff was travelling hard, being attached to Mr. Shering's mission, and, in my opinion, not prepared from that point of view to tackle a mountain of the first class, and not at all prepared with food, from what one might call a professional trainer's point of view. Further, nearly the whole of their reserve of strength must have been expended in those marvellous moments on the avalanche, and during that terrific night. I place their performance as the one which gives us most hope, but we must take care to eliminate the little jokes they indulged in, and have a more normal outlook.

Our model should be the next on the list, the Duke of the Abruzzi's: a model from any point of view, whether of reaching a great height, or of scientific observations, or of dealing with the natives. Remember I

merely say a model. I do not say that it was necessarily economically carried out, or that the over-payment of the Balti did not make it difficult for more humble travellers who followed after, but a model for Mount Everest, in that it was completely and well equipped, was composed of first-rate men only, whatever their business on the expedition was, and that no effort was spared to render everything adequate to obtain the required end.

Again Alexis Brocherel was of the final party. They reached a height of 24,600 feet, and this is up to the present time well the highest measured point attained. Further, they took native porters up to a height of 22,500 feet, and their men remained there under very adverse conditions of weather for many days. They themselves were terribly hampered by bad snow. Given a fair chance, with a fortnight's good weather, and in consequence good going, and there is no doubt a much greater height would have been reached. Possibly even Bride Peak itself would have been climbed. It is well and often said that the easiest mountain may be rendered impossible by bad weather, and soft snow is one of the greatest possible enemies at a great altitude. It will be seen that their pace was slow, about an average of 250 feet per hour. They were evidently nearly at the end, and had little chance owing to the softness of the snow: a possible, though not so likely, condition that may also be found on Everest. Here we have an expedition run on entirely different lines from Dr. Longstaff. Their food had been packed in special tins. Each tin contained a balanced diet for so many people, as should be done by us as well. They had not been, or ought not to have been, worn out by too much hard carrying of their own camp at high altitudes. Their route also was not too difficult; it is almost certain it was due to snow conditions that they did not attain a much greater altitude.

Next I place bracketed the climbing of Trissul (23,400 feet), Messrs. Rubenson and Monrad Aas on Kabru at 23,800 feet, and Dr. Workman's climb of 23,400 feet on a ridge above the Chogo glacier in Baltistan.

On the first great climb there were again Dr. Longstaff, the two Brocherels, and Subadar Karbir Burathoki of the 1/5th Gurkha Rifles, who had been with Sir Martin Conway's Karakoram expedition and his journey in the Alps "from end to end." A high camp had been made at 20,000 feet, but a hurricane confined the expedition for thirty hours to their bivouac tents, and obliged a descent to 17,400 feet, and a re-ascent for the climbing party from that comparatively low elevation. I do not include hurricanes in my preparations for a model expedition, or as a training adjunct: hurricanes sap the strength, and don't improve it. This one compelled a descent and re-ascent, also undesirable. Finally the climbing party ascended from about 17,500 feet, climbing over 6000 feet in a day at a great height, a notable performance. The condition of the snow was good. Messrs. Monrad Aas and Rubenson's attempt on Kabru

was probably as noteworthy. There was no professional assistance, and only a scratch but very successful team of Bhotias. Kabru is immensely fatiguing, but not difficult. This climb is noteworthy by reason of the amount of baggage taken high, and the cheerful and willing co-operation of the Sher Pa Bhotias.

There have been other noteworthy high explorations which give us hope, and also point their particular lessons. Such is Slingsby's attempt on Kamet. He reached a very great height under the most adverse conditions, with unwilling and frightened Marcha Bhotias and bad weather. It must be admitted that the Marcha Bhotias' foot gear is the very worst for the mountains I have ever seen, giving no hold in the snow, nor any protection. From the point he reached, Kamet would probably have been climbable by a fresh party; but Slingsby was quite played out, and did not recover for a year afterwards. He was a complete enthusiast, and a thorough sportsman in the highest sense. Himalayan exploration suffered a very great loss by his early death, and that of his cousin, Major Todd, of the 5th Gurkha Rifles.

Dr. Kellas' innumerable Himalayan expeditions are as important as any—notably his ascent of Pawhunri in northern Sikkim—and no one has done better work than he, or knows more about the effects of high altitude on the human frame. He has just lately been making a second visit to Kamet, and the result of his explorations and physiological tests will be of the utmost importance to the Mount Everest expedition, both in making its preparations and in its subsequent conduct.

We have also the climbs and explorations of Mrs. Bullock Workman and her husband. No one has travelled more consistently, but I do not think there is much in their experiences which will be of special use to us in our contemplated expedition.

Such was the position when I finished writing this paper, but during the last two days the following information has been received. The saddle reached by Mr. Meade during his explorations and attempts on Kamet in 1914 has been officially measured by the Indian Survey Department and turns out to be no less than 23,500. Mr. Meade fully established a camp at this point, and this camp is by far the highest yet made, and it is also by far the highest point at which an explorer has passed the night. This comes from an officer of the Survey of India, who writes that this year Dr. Kellas with Major Morshead reached this same col, but was unable to get his coolies to the col itself, and therefore was unable to camp there. Since this information was sent Dr. Kellas has made yet another attempt to climb Kamet, and let us hope a successful one.

Two other performances to me are as important as any, not so much from the actual height obtained as for what it gives us a right to expect. First comes Mr. Mummery's final attempt on Nanga Parbat by its W.N.W. face. For forty-eight hours he and the Gurkha, Ragobir Thapa,

MOUNT EVEREST FROM CHUNJERMA LA, 15 MILES SOUTH-WEST OF KANGCHENJUNGA

Tele-Phot. by Sign. Vittorio Sella on Mr. Freshfield's expedition to Kangchenjunga, 1899

MOUNT EVEREST FROM KAMPA DZONG

Tele-Phot. by Mr. J. Claude White on the British Mission to Tibet, 1903.

were engaged in the most terrific rock climbing it is possible to imagine, and finally reached a height of 21,000 feet. The most desperate gymnastics hour after hour at this great height were a prodigious exertion. I put the difficulty of the climb as quite the equivalent of another 5000 feet of elevation on better ground, and I know I am not exaggerating at all. The second example includes two climbs by Major Todd, with Heinrich Führer, a Swiss guide, and the Gurkha Chandra Sing, on a mountain of the curious name of Mewakundini, which is just under 20,000 feet, which again entailed the very hardest gymnastics on both rock and ice; and another unnamed peak of about 21,000 feet, of less difficulty, but which they accomplished in rough weather at a pace which would compare favourably with the ordinary pace on a 10,000-foot Swiss peak. In my opinion both were remarkable athletic performances.

I give these instances as I know well the places where each was accomplished, and am able to judge. I consider it gives a very fair line on which to judge what we can expect from probably still better men, properly trained and taken care of, as our final climbing party should be on Everest.

Now we come to the constitution of the proposed expedition. It is to be a combined Geographical Society and Alpine Club party.

The Alpine Club members are to organize and carry out the actual climbing of the mountain. The Geographical Society undertakes the scientific side, and hopes for the co-operation of the Survey of India. There is of course great hope that functions may overlap, but it is also necessary that the climbing members should treat themselves seriously from their point of view, and whatever other work they undertake must, in their case, be to them a side show. The Geographical members may, and it is hoped will, assist in the climbing, but their side show should be the climbing.

There should also be a base commandant, who would be responsible for food supply for the porters, arranging for camps, etc., in fact a general utility man. He should also be general interpreter, and might with advantage be an officer of a Gurkha Regiment. I know, however, of one Indian civilian in particular who would fill the post very well.

Again speaking of our Alpine party, I am convinced that as few nights as possible should be spent at great heights. It is much better to come down as far as possible for a good rest, and re-ascend when fresh, than to try and recover from fatigue by lying up at a great height. The height itself is against recovery. It might, even if several attempts were necessary, be right to get the party back to such comparatively low elevation as 15,000 feet. Dr. Guillarnod's expedition passed, I think, a greater number of nights without descending than any other expedition, and were certainly badly affected by so doing.

I will bring this lecture to a close by referring once more to the name of Mount Everest. It would be a great misfortune if the present

beautiful and suitable name were ever changed, even although it is actually the name of a late and honoured Surveyor-General and not a native name. At the same time there is no harm in speculating on what the native name may be. It is doubtful if the actual peak has one at all. Colonel Wood has clearly shown that the name Gaurisankar belongs to another group, and there are no backers for Brian Hodgson's Deva Dhunga.

It is not true, though, that natives of Nepal have no names for single peaks, for any Gurkhas from Central Nepal are familiar with the names of Macchha Puchri, Dhaulasiri—or Giri, Chibchibia, and Gosainthan, and others. My Sher Pas from the Dudkosi, whenever I have questioned them, gave the name Chomolungmo for the Everest group: I thought at first for the actual peak, but I think now for the group. They also, and unshakably, called Makalu "Kamalung," except Darjeeling men, who knew Englishmen used the former name for the mountain. In fact, I have never discovered any one else who knew the name of Makulu. Mr. Freshfield quotes the name Chomo Kankar, probably also for the group, and there is no reason that shouldn't be right. His authorities were Colonel Waddell and Chandra Das. Major Noel also obtained what he believed was a local name, probably also quite correct. He obtained this on his journey in 1914 to find a short and direct approach to Everest from the east and south-east *viâ* Tashirak, an exceedingly ambitious project. It was a real bit of exploration, and I believe he traversed country not before crossed by an Englishman, and of intense interest.

There is a river in Nepal, one of the affluents of the Trissul, which I called the Dharmdi. I was told I was wrong, and that its name was the Dharmkhola. Di is the Maggar word for river, and Khola the Nepali. I give this instance to show how very easy it is to confuse local names.

Even if this proposed expedition finds its real name written clearly on the mountain, I hope it will take no notice, as I am sure you will agree that no name is so beautiful and suitable as Mount Everest. May the 2 feet never be cut off its 29,002! Luckily the loss is now rendered more difficult, as the latest computation credits the mountain with 140 more.

One final word. I am sure that whoever takes part in this proposed exploration will join with me in regretting that the late General Rawling does not form one of the party, for I believe it was his life-long ambition, and that in all probability if he had lived he would have been himself one of the actual leaders.

Before the paper the PRESIDENT said: In my Presidential Address this year I stated that the Alpine Club and our Society were interesting themselves in plans for the ascent of Mount Everest. Since then the Secretary of State for India has been good enough to receive a deputation from our two Societies

and to express his sympathy with the project. Colonel Howard Bury then on our behalf—though we acknowledge with gratitude at his own expense—visited India to explain our wishes to the Government. He was cordially received by the Viceroy, who recommended him to visit Sikkim and talk the matter over with the local officer. Unfortunately it has been decided that for political reasons the present is not a propitious moment for actually commencing operations. But in the meanwhile till the political horizon clears we may well occupy ourselves in reviewing the whole project, for it will never be eventually successful unless it is planned out with particular attention beforehand. Utmost care in detail must go hand-in-hand with boldness, and the ascent of Mount Everest, one will realize, requires boldness in the extreme.

First let me say a few words about the general idea of climbing Mount Everest, for I want to get the idea enshrined in the very heart of this Society. I have never myself been a peak climber or acquired the art of Alpine climbing, but I have had ample evidence of the practical value of mountain climbing. When exploring a new route across the Himalaya in 1887, I came to the Mustagh Pass. What carried me over was the remembrance of the deeds and example of Alpine climbers. As I looked down the awful precipice I had to descend, I confess I felt terror, and if I had lived a hundred years ago I should not have dreamed for a moment of attempting the passage. I should have assumed as a matter of course that it was impossible, but with the recollection of what Alpine climbers had done in Switzerland, and what sportsmen do in India, I pulled myself together, took the plunge, and got over all right. And having, through the example of the Alpine Club, successfully negotiated the Mustagh Pass, I was able in subsequent years to tackle many other unknown passes in the Himalaya. And having become accustomed to Himalayan passes, I did not hesitate to advise the crossing of the Himalaya even in the depth of winter when I was leading a mission to Tibet in 1904.

The high spirit of the Alpine Club thus percolates downwards till it reaches us lowly geographers, soldiers, and political officers, braces us up, and enables us to carry out enterprises we should, but for their example, never have attempted. The ascent of Mount Everest will have the same effect to an increased degree. Our forefathers were terrified of mountains, and called the most ordinary peak inaccessible. Nowadays we refuse to admit that the highest mountain in the world cannot be scaled, and the man who first stands on the summit of Mount Everest will have raised the spirit of countless others for generations to come, and given men a firmer nerve for scaling every other mountain.

A further good result will follow. The ascent of Mount Everest will be preceded and followed by ascents of numerous other Himalayan peaks, and as we pit ourselves against them, we shall get to know them better, and as we get to know and understand them, we shall finally rid ourselves of the ridiculous idea of the littleness of man in comparison with mountains. We shall realize that man is incomparably greater than any mountain, but at the same time we shall see a beauty in these mountains which only those who have wrestled with them ever see. The beauty of the Alps was never properly appreciated until men climbed them, and it will be the same with the Himalaya: as we climb the Himalayan peaks and get to know them properly, we shall begin to enjoy their beauty, and the enjoyment of their beauty is the second result, and one of inestimable value, which will follow from the ascent of their highest summit. I have said that the first man to ascend Mount Everest will raise the spirit of countless others. Much also to raise it was done by the first man bold enough to conceive the idea. That

man—as I told the Society three years ago—is General Bruce. General Bruce has climbed in the Himalaya for nearly thirty years, and is known from one end of these mountains to the other. What is more, he is known not only as a great climber, but also as a great companion; in any party he joins he is the most loyal member of it. A further recommendation to us is that he is a son of one of our most distinguished Presidents, the first Lord Aberdare. On all these accounts we welcome him most warmly among us.

General Bruce then read the paper printed above, and a discussion followed.

The PRESIDENT: We are fortunate in having the Alpine Club well represented here this evening, by its President, Prof. Norman Collie, and two ex-Presidents, Mr. Freshfield and Sir Martin Conway. I call upon the President of the Alpine Club, who was one of Mummery's party to make the attempt on Nanga Parbat, and who can appreciate what mountain climbing in the Himalayas means.

Prof. NORMAN COLLIE (President of the Alpine Club): As you have heard, this expedition to Everest is to be a joint expedition of the Geographical Society and of the Alpine Club. Two things of course naturally have to be determined about Everest. Firstly, it is of the very greatest importance that we should know something more about that part of the world out of which springs this very highest spot on the globe, Mount Everest. At present we know practically nothing. No white man has ever been within 40 or 50 miles of Everest, and all the country round it is unknown. Secondly, people can be sent who are capable of showing how it will be possible to get to the top of this mountain. Naturally, I think it is a great prize for the Geographical Society to have almost within their grasp, this most interesting part of the world as yet unknown and unexplored, and I wish it was as easy for the Alpine Club to say that the winning to the top of Everest was as easy. It will need an immense amount of work, an immense amount of labour, and it will be a most difficult thing indeed to climb to this highest point in the world's surface. The President and the Geographical Society have taken a very great deal of trouble in order to make this expedition successful, and I certainly hope it will be started next summer. The first expedition will necessarily not have much to do with the climbing of Everest. The way there will first have to be found; then, having got to the bottom of the mountain, a possible route up to the peak might be suggested. This will take quite the whole of the time of the first year's expedition. In the second year's expedition there will have to be a properly equipped climbing party. They will probably find that the suggested route may not be successful, and may have to change it; that will mean that they will not have time to change their route in one year, but will have to come back another year, and therefore it is not one expedition, but many, which will have to go to Everest before anybody is likely to set foot on the top. One other thing: most certainly if any expedition is allowed to go into this unknown and forbidden land round Everest, the expedition ought to be a British expedition; under no conditions whatever should the British Government allow other people to go there before us. After having waited so long for leave to approach Everest, I think we really have prior claim to any one else to go into that country. Moreover—and now I speak from the Alpine Club standpoint—it is the Alpine Club which has taught the way to climb mountains. Every other Alpine Club in the world, and most of the climbers of mountains, have been followers of the first members of the Alpine Club. It was the members of the Alpine Club that

first began serious climbing in the Alps, although De Saussure first went up Mont Blanc, and it was fifty years almost after that before any other big mountain was ascended, and even then no one really took up climbing as a serious recreation. The members of the Alpine Club first made climbing in the mountains a successful venture, and therefore I think under those conditions it ought to be not only English people, but members of the Alpine Club, who must have the first say in the matter of climbing Everest, the highest mountain in the world.

The PRESIDENT: I will ask Mr. Douglas Freshfield, who made that wonderful climb round Kangchenjunga some years ago, if he would address the meeting.

Mr. DOUGLAS FRESHFIELD: It is a great pleasure to me to see an expedition to climb the highest mountain in the world, which I have dreamed of for at least fifty years, carried into effect. I had hoped, but for the unfortunate interruption by the war of all our normal activities, that it might have happened during my own Presidency, but it is now a consolation to me to find it undertaken by a President who can bring more influence than I could bring to bear to overcome the initial difficulties—the official obstacles. I hope most heartily it may be during our present President's term of office that the summit of Everest is reached. I will condense what I have to say as far as possible. First as to season and weather. The shortness of the interval between the end of the monsoon and the first heavy snowfall is a very serious hindrance to mountaineering, at any rate in the Eastern Himalaya. Is it possible that in the early summer, before the monsoon, the ice and snow might be found in better condition? Again, it is doubtless true that on the north side of the range there is far less mist and snow than on the southern slopes; but Tibet is far from immune from summer snowfalls. The great storm of September 1899 covered the whole district north of Kangchenjunga about a yard deep in snow and put a stop to any high climbing—nearly put a stop to all exploration; and this year Mr. Raeburn, a noted climber who went out to Kangchenjunga, has, I hear, been similarly hindered. As to the effects of altitude up to 21,000 feet: few members of my party were seriously affected. I myself at the age of fifty-five experienced no more than a sensation of lassitude, just as if I had taken up a heavy knapsack. Dieting is very important. Improper food was one of the principal causes of the great suffering in the High Alps amongst the early pioneers—sufferings we hardly ever hear of to-day.

As to transport, my experience may be to the point. Our party carried the baggage of over fifty men, including provisions for a fortnight in advance, and heavy photographic apparatus over a pass of 21,000 feet, in the worst conditions, after a heavy snowfall which had spread from 2 to 3 feet of soft snow over the whole range. With all that General Bruce has said with regard to coolies I agree, but they have one regrettable failing: they hate getting up early in the morning, and are eager to have a hot breakfast before they start. The consequence is they often have to wade in snow which would have been hard a few hours earlier.

My next point is local topography; the nature of the approaches to Mount Everest. In the Eastern Himalaya on the southern slope you come to a point where glacial protection has ceased and erosive action by water and ice has had full play. In the Teesta valley this point is well marked; below it the river flows in a deep gorge, higher up through an open valley. There is probably a similar point in the Arun basin. Its situation should be easily ascertainable by aeroplane. Machines could fly up from the plains of India and back

again in the day: they might also be used for telephotographic purposes, and even possibly for dropping provisions at high bivouacs. As to the character of the climbing on the great peak, I have seen it nearer than most people, and I should be sorry to commit myself to any prophecy. The ridge from its northern shoulder to the top is, it is true, not steep, resembling seen from a distance that from the Aiguille du Gouter to the Dôme on Mont Blanc, but we know nothing of the middle part of the mountain, which in the Himalaya is apt to be the worst.

Last, as to nomenclature. I adhere firmly to the general principle that it is a mistake to affix personal names to great mountains. We should all have been sorry if Mont Blanc had been called Mont Paccard or Mont Saussure after its early climbers; and when the individual has no claim to connection with the peak the case is stronger. But I do not propose to reopen to-night an old controversy in this particular instance of Mount Everest. For I recognize there comes a time when the inconvenience of any change may more than counterbalance other considerations.

The PRESIDENT: We have heard of Captain Longstaff's wonderful climb. If he could give us the advantage of his experience we should be very grateful.

Captain LONGSTAFF: It has been naturally a great delight to me to listen to this paper of General Bruce's; it reminds me of a most happy six months with himself and Arnold Mumm, who was then Secretary of the Alpine Club, when we went to console ourselves with Trisul to celebrate the jubilee of the Alpine Club in 1907. We had hoped to go to Everest, but the lack of sympathy with geography of the Secretary of State for India prevented it. I am sure that every climber of experience agrees with General Bruce's thesis. There are many things one would like as a climber to say on these most interesting subjects, but there is not time, and there are others who have greater experience than I have. There are also many questions of great geographical interest involved. General Bruce objects to my slapdash methods of mountaineering. I will remind him of the crossing of the Bagini Pass in 1907, which I think bears a very fair comparison with the sort of thing he accuses me of. He will remember all about it. Of course, seriously, General Bruce is perfectly right. There can be no question but that with a mountain like Everest you must adopt Polar methods. The dashing at the first thing you see is a very pleasant pastime for youth, but it is not the way to get up any very high mountain. We must adopt these Polar methods. We must divide our work into at least two years; we must find out whether there is what we call an easy route up Everest. If there is no easy route we shall not get up it! Therefore it is most important—I wish, Mr. President, to make this point strongly—that in the first year, when the reconnaissance party is to go out, this party should include as many experienced climbers as possible, not with a view to climbing the mountain, but with a view to finding the route; without mentioning names, there are two members of the Alpine Club who are both officers of the Royal Engineers, both members of the Survey of India, both of the right age, who have both extremely good experience—varied experience of mountain work—and I think it would be a thousand pities, considering that you have two men like this in India, if they were not permitted to accompany the expedition, because we want trained topographers with mountain knowledge to tell us mountaineers at home whether a route is possible or not. Without there being any idea of these particular men doing the climb we must have as many trained topographers with mountaineering knowledge in the first year to give us some idea of what the mountain is like. Having done that, I agree with General

Bruce. We must have a gang of trained coolies. The best men I ever had were Bhotias from the north-west corner of Nepal; and in Tibet on Gurla Mandhata they did splendidly. I do not think it is necessary to give high wages, but you must feed them well, and sleep them well, and blanket them well, and shoe them well, otherwise you cannot expect to get anything done. When you have found your route and got your porters together, then I think you must make a base camp as low as you can on Everest, say about 16,000 feet. Then with your team or teams of porters you have got to turn to Polar methods and lay camps ready for the actual climbers—say a camp between 21,000 and 22,000 feet for the climbers; the coolies that make that camp may take two, three, four days, or longer, but the actual climbers will have to climb from 16,000 to 22,000 in a day, and the next day from 22,000 to 26,000 in a day. If they cannot do this, they won't get up Everest! I am convinced, and my friend Meade too, I know, who has climbed higher than Trisul with guides and with native porters, will tell you he agrees with me, the longer you stay above 20,000 the weaker you are going to get. We do not believe in acclimatization in that way. Do not stay up—go up as often as you like, and then come down. There is only one cure for mountain sickness, and that is to come down. If they are going to take longer than three days' actual climbing they won't get up Everest! I believe that the reason why the Duke of the Abruzzi went slowly on his final climb was that they spent too many days over 18,000. I can only refer to my own experience. On our ascent of Trisul, on the last day the successful party did 6000 feet in ten hours, 600 feet an hour. They came down 7000 feet in three hours. It is perfectly easy to come down—anybody can come downhill. Graham made the same progress on the ascent of Kabru. There is no reason, I believe, why climbers who have the necessary physiological attributes, not necessarily mere physical strength, if they are carrying no weight, if they have not to carry their food and tents on their backs, should be unable to climb at the rate of about 500 feet an hour. If they are not going to be able to climb at that pace they won't last out the cumulative trials of low pressure. But even in this case, the geographical results alone would be a full and sufficient reward for this most necessary venture.

The PRESIDENT: Colonel Wood was sent to decide whether there was any higher mountain than Everest at the back of the Himalaya. He found there was no higher mountain. He has seen Everest, I think, nearer than any one else, and we should like his account of what it looks like from the northern side.

Colonel H. WOOD: I was fortunate enough to be sent up in 1903 to investigate the nomenclature of Everest, and I was able to see the mountain for a short time then, and again with Colonel Younghusband, unofficially, I went, along with Ryder and Rawling, up the Brahmaputra, when we saw it from the north. It is fifteen years ago, and my memory of it is rather faint, but it certainly is a most stupendous undertaking to attempt to climb it. The gorges are very great, and I do not think there will be anything very easy in the route there, and therefore the reconnaissance is most necessary. Of course the geographical side is more interesting to me than the other, although I wish I was younger and able to attempt the climb myself. I am sure the Survey of India will give any assistance wanted. I hope, also, the Survey will be considered in the climbing, and one of our younger members will be allowed to go up. Prof. Norman Collie says it should be an English party, but I think a Survey of India one, as it is named after our original Surveyor-General. I

have been asked to say what I remember of the mountain from the northern side. It was generally rather cloudy, and there was a great deal of mist about, but there is no doubt it stands up a most enormous peak. It is, I think, on a spur about 20 miles to the north of the main range. You see it with all the big Himalayan peaks as a background, and it stands out by itself—an absolute giant.

Mr. C. F. MEADE: I am afraid I can claim only a very limited experience. I know only the district which Capt. Longstaff was first referring to. I agree very heartily with what he says, and especially about the speed of coming down. I may say that the thought of the rapidity with which, if necessary, one can come down again, is a perpetual comfort and inspiration. One has that great advantage over Polar expeditions in being able to come down again. I am afraid I cannot claim to have reached any much greater height than my camp on Kamet. We succeeded in camping at 23,500 feet, but the sequel is not very brilliant. We passed the night there and were ready to start the next morning, but the previous day we had had about 100 steps to cut in very hard ice, and I think no one who encounters much step-cutting at great heights has a fair chance of doing much. Another thing I have always found in June is that the snow has always been in a powdery condition, and this is extremely exhausting, and in my opinion likely to be prohibitive. I notice that Dr. Kellas and Capt. Morshead, who have just made their recent attack on Kamet, have reached the same saddle, though their coolies could not get the camp up to it. They had decent weather and did not find the snow bad. This may be due to the effect of the season, September, and I think September instead of June may be a more favourable month.

The PRESIDENT: The time is getting on and I must bring this interesting discussion to a close, but I should like, if I may be permitted, to make a few observations. General Bruce said that I told him we could see Mount Everest from Kampa Dzong during the months of July, August, and September. I remember perfectly well seeing Everest at a distance of 100 miles, and to my remembrance I could see it nearly every day, and I asked Sir Henry Hayden of the Geological Survey, who was there in September, and his recollection is the same. Nearly every day, certainly at the time we were there, Everest could be seen. That means to say that the monsoon did not fall upon Everest as it does upon Kangchenjunga and upon other Himalayan peaks. The fact is, as Col. Wood has said, Everest stands well back from the general line of the great peaks, and it has in front of it (and this is a very important point) two peaks of 23,000 and 24,000 feet which serve as a buffer in between it and the full brunt of the monsoon. That is rather a favourable point, for it means that it may be possible to climb Everest in the hottest months of the year, July and August. I want to say, and to say it with emphasis, that I concur with General Bruce that a very great deal can be made of these Himalayan people if they are properly treated. He referred to the Baltis and mentioned especially the village of Askoli. It so happened that the guide who showed me over the Mustagh Pass was a Balti and was from this very village. I engaged him in Chinese Turkestan, where he had lived for twenty-five years. He certainly was not pressed into the service, but came entirely of his own accord. When we came to a very nasty part where he might quite well have given up, he said "No," he had undertaken to show me over, and would not go back until he had carried out his undertaking. The Duke of the Abruzzi's experience was precisely the same as General Bruce's and mine, that an immense amount can be got out of Himalayan people if they are treated well, given a thorough interest

in the expedition, and, as Captain Longstaff has said, clothed well and shod well. If these matters are looked after, I am certain amongst these Himalayan people there can be got together a party of well-trained men who will form a carrying party for the expedition. As regards survey. One would very much hope that a member of the Survey of India should be the first to climb Mount Everest. There is no reason why that hope should not be combined with the President of the Alpine Club's suggestion that the climber of Everest should be a member of the Club. As Captain Longstaff has said, there are two very fine Alpine Club climbers already in the Survey of India, and the more members of the Survey of India who join the Alpine Club the better. Lastly, I should like to corroborate all General Bruce has said as to the Duke of the Abruzzi's expedition having been a model one. We could not do better than model our own expedition for Everest upon the model of the Duke of the Abruzzi's K_2 expedition. Now I will ask you to join with me in giving a very hearty vote of thanks to General Bruce for his valuable paper. General Bruce is one of those men who have explored most in the Himalayas, and all his observations upon the treatment of the people are of special value because he belongs to a Gurkha regiment, and no man knows how to handle people of the Himalayas better than he does. It is known probably to most of you that in the Gallipoli campaign his presence alone was considered worth a whole Brigade.

TOPOGRAPHY OF THE GOLD RANGE AND NORTHERN SELKIRKS, BRITISH COLUMBIA

Howard Palmer

ALTHOUGH the valley of the Columbia River north of Revelstoke, British Columbia, has been a route of travel for a century, and fifty years ago it was the scene of a full-fledged "gold rush," there is available no adequate account of its physical features. Bordered on the east by the outlying foothills of the Selkirks and on the west by the Gold Range, both of which occupied practically unmapped territory, it promised to well repay geographical investigation. The present paper aims to report briefly the results of a month's reconnaissance of the region made by the late Major Robert H. Chapman and the writer.

From Revelstoke on the Canadian Pacific Railway there extends northerly along the river for 117 miles "The Big Bend Trail." This is maintained by the Government for fire patrol purposes, and affords practically the only land communication with the district embraced within the great northerly loop of the Columbia. A ferry near the tip of the Bend enables connection to be made with another section of the Government trail that strikes the railway again at Donald. We were told that branch trails gave access to some of the lateral valleys, and by these we planned to penetrate into the Selkirks and make a plane-table survey of as much of the new ground as we could. We expected to extend the author's earlier surveys of the lofty Mount Sir Sandford district westerly

over the lower intervening mountains, utilizing his stations to obtain the plane-table locations.*

With two men and three pack-horses, we set out from Revelstoke on June 22. Although south of the town the valley floor is more than a mile wide all the way to the Arrow Lakes, to the north it disappears altogether and the river rushes rapidly through a narrow and steep-sided valley for most of the distance to the "Big Bend." Dense luxuriant evergreen forests fill the entire landscape, so that until Carnes Creek, 20 miles distant, is reached, only the rough lower slopes of the mountains can be seen. Over these along the easterly bank the trail winds in a haphazard way, with many an up and down, keeping closely to the river. Cut-banks and the gorges of side torrents present oft-recurring obstacles.

Near Carnes Creek the valley bends to the west and the Gold Range takes on a more imposing aspect, supporting glaciers here and there. The most conspicuous peak is "The Frenchman's Cap," a Sir Donald-like prong of dark rock which rises 7000 feet abruptly from the Columbia to a height of 8500 feet above the sea. Farther back from the river a group of serrate peaks is possibly a little higher.

The general arrangement of the Gold Range for 100 miles north of Revelstoke may be compared to the bones of a fish—the water-parting, from 10 to 20 miles west of the river, serving as the backbone, while roughly parallel spurs and subsidiary ranges branch off diagonally in an easterly or south-easterly direction. The valleys between these lateral ridges are deep and U-shaped, often becoming actual gorges as they debouch into the Columbia. In the other direction they generally open out into spacious upland basins and snowy plateaus. Several are typical hanging valleys. The mountains rise to heights between 8000 and 9000 feet, and as the Columbia averages only a little more than 1500 feet above the sea, the terrain displays a by no means insignificant relief. For convenient description, this 100-mile section of the range naturally falls into two parts: the first, extending from Eagle Pass on the railroad 50 miles to the pass at the headwaters of Gaffney Creek, where a wide low saddle opens through into the basin of the Seymour River on the west; the second, from Gaffney Creek Pass northerly to the valley of Canoe River.

In the first division, the mountain ridges are characterized over great distances by even crests and long sweeping lines, with flattish slopes dipping towards the north-east. On these the principal glaciers are to be found, a few being several square miles in area. For fully 8 miles south-easterly from Gaffney Creek Pass an almost continuous glacier mantle covers the northerly slopes. Towards the west and south-west the gradients are more abrupt, oftentimes breaking out in lofty cliffs.

* See "Explorations about Mount Sir Sandford," *Geographical Journal*, vol. 38, pp. 170–179 (1911), with map; and 'Mountaineering and Exploration in the Selkirks' (1914), by Howard Palmer, pp. 139–393, maps and illustrations.

A few of the outlying spurs exhibit a fretted topography, apparently due to the action of local glaciers. The "Frenchman's Cap" group mentioned above is typical of this sculpture and appears to contain the dominating elevations in the section.

Between Gaffney Creek Pass and Canoe River the Gold Range takes on a more rugged character, although preserving the arrangement already noted. The general uplift increases, and both the main axis of the system and its offshoots display more individual peaks. A sub-equality of elevation is noticeable here as well as in the Selkirks and the Rockies. There are fewer of the broad, slightly tilted slopes, so favourable for the alimentation of glaciers, and we find a corresponding decrease in the number as well as in the size of the latter, although in the neighbourhood of the pass there are some extensive névés. The most prominent elevation hereabouts is the Gordonhorne (about 9500 feet). This is well seen from the trail when approaching Goldstream, and apart from the "Frenchman's Cap" is the only mountain of note visible from the depths of the valley. We obtained a splendid view of this entire section from a peak between the head of McCulloch Creek, a small northerly tributary of Goldstream, and the Columbia. Although only 7950 feet high, it commanded the whole range from Mount Begbie near Revelstoke at the south, to the high mountains along Canoe River at the north, a clean sweep of 100 miles. It was somewhat of a surprise to note a pronounced scarcity of important and really prominent peaks for so extended an array. It is a question whether any exceed an elevation of 10,500 feet, but there are three and possibly four that are entitled to be ranked in the 10,000-foot class. The chief of these appeared to be on the westerly façade of the range about 30 miles distant, well beyond the westerly source of Horne Creek. It displayed a remarkably long even-topped summit, whose easterly face is entirely covered with glaciers. Later on we saw it frequently from the heights about Mica Creek, and it certainly will rank among the biggest peaks of the range. Proceeding northerly, the next two elevations of prominence were too far off to be accurately described. They must lie fully 25 miles back from the Columbia, and evidently mark the vicinity of the backbone of the range, which here commences to trend more sharply towards the north-west. The fourth summit rises between Foster Creek and Canoe River. We were able to plot this approximately later, and estimate that it approaches an altitude of 10,500 feet.

Turning to the Selkirks, the geography of the extremity of the range which had so long remained *terra ignota*, baffling observation even from the top of Mount Sir Sandford itself, now yielded up its treasured secrets most accommodatingly. We saw that the orographic key to the puzzle was Bigmouth River, whose three branches spreading out like the fingers of a hand received the drainage from two-thirds of the region beyond the Windy River Range, including all from Mount Argonaut (to be referred

to presently). The length of this torrent was a surprise—the trunk stream cutting easterly almost to the Columbia on the easterly side of the Bend. Between the trunk stream and its northerly affluent rose a splendid new peak covered with snow which dominated its entire neighbourhood. Later on we learned more about it. Mount Palmer, Mount Guardsman, Belvedere Peak, and many others near Sir Sandford were in full view, not to mention Iconoclast, Sorcerer, and Holway towards the south. Our peak, therefore, offers a rare opportunity to the surveyor who desires to extend triangulation across the range.

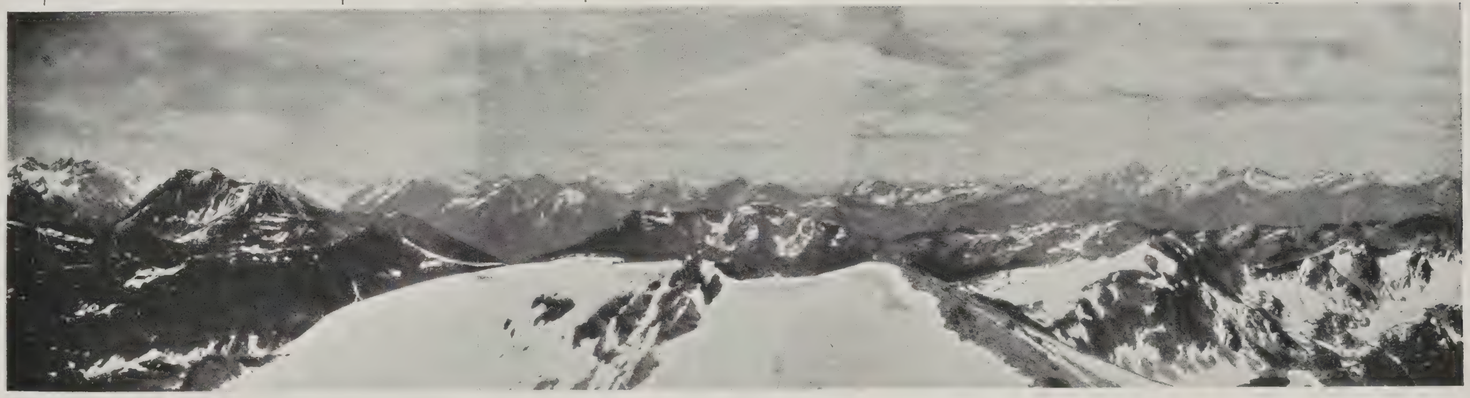
From another station (7330 feet) to the north-east of McCulloch Creek we viewed the entire valley of French Creek. A fine glacier constitutes its principal source. The valley is deep and straight, and through it the stream meanders for miles between swamps and small lakes.

The position of the water-parting of the Selkirks, however, eluded us, so another day was spent in occupying a third station towards the north, distant about 5 miles. The pastoral character of these outlying spurs of the range (6000–8000 feet) was very favourable to our work; they resembled the White Mountains of New Hampshire, with smooth rounded slopes carpeted with grass and flowers and whitened here and there with snow banks. It was possible to travel about almost as one willed, without the obstruction of deep timbered valleys. Towering cliffs and jagged outcropping rocks do not, as in the eastern Selkirks, sound the emphatic keynote of the scenery.

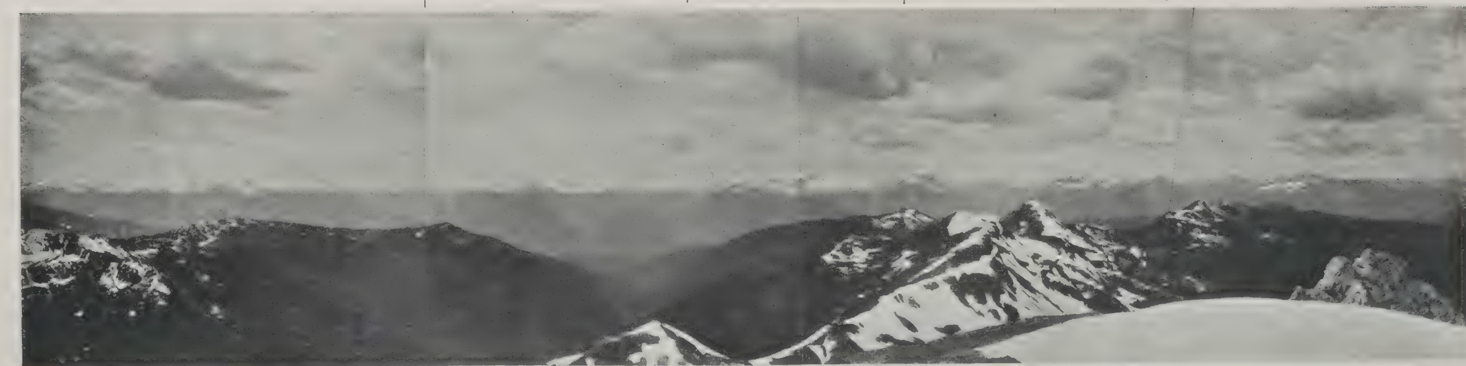
From our station (7750 feet) we had a good view of Mount Argonaut and its approaches. This mountain, named and located by the writer in previous years from the Mount Sir Sandford district, it had been part of our present programme to ascend. In those days we dubbed it "The Big Tooth Peak," by reason of its prominence and striking form. It was the most conspicuous peak on the westerly horizon, and seemed by its isolation to promise a panorama of the entire Bend. Now when we were actually face to face with it, our anticipations were not realized. The altitude worked out something less than 10,000 feet, and the aspect of the mountain from this (the south) side lacked dignity and impressiveness. It was further off than we had expected, and with the lower slopes fire-scarred and strewn with piles of down timber, heaped up like giant jack straws, we concluded that the ascent would not repay the time and effort needed.

Having now completed the necessary plane-table work from our headquarters here in Groundhog Basin, it was a question whither to move next. The high peaks of the range clearly lay well over towards the Columbia above the Bend, so we naturally felt drawn thither. On the other hand, we would have to travel up the Columbia valley half as far again from the railroad as we had already come, with no positive assurance that we could get up into open country above timber-line, which is essential to the conduct of a rapid survey. Failing in this, our efforts

KETCH-MAP OF THE NORTHERN SELKIRKS, FROM THE MAP BY HOWARD PALMER ND THE LATE R. H. CHAPMAN, 1915. (PREPARED AT THE SURVEYOR-GENERAL'S FFICE, OTTAWA.)

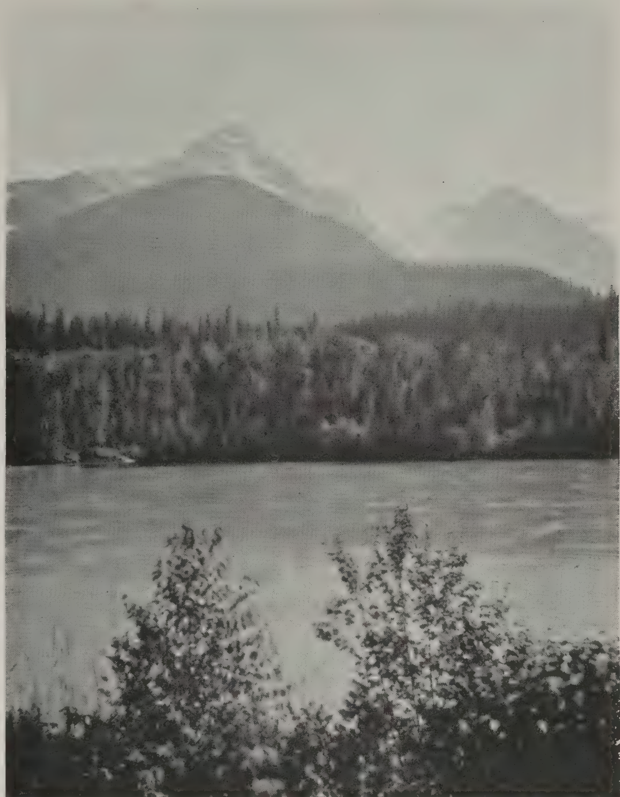


Panorama of nearly 180° looking east: Main range of Selkirks



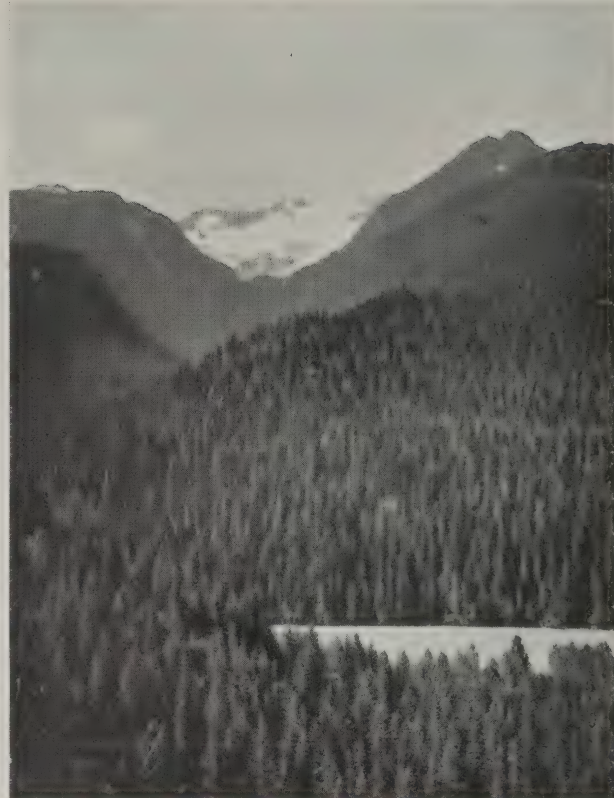
Panorama of nearly 180° looking west across valley of Columbia River to the Gold Range.

PANORAMAS FROM STATION 2423 m. NORTH-WEST OF HEADWATERS, McCULLOCH CREEK



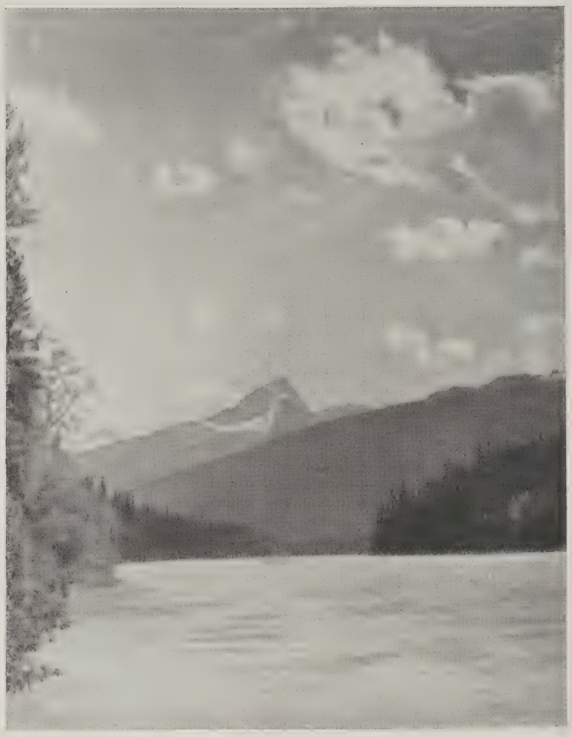
THE GOLD RANGE AND COLUMBIA RIVER FROM NEAR CARNES CREEK

Phot. by R. H. Chapman



THE GOLD RANGE ACROSS THE COLUMBIA RIVER NEAR CARNES CREEK

Phot. by R. H. Chapman



NORTH FACE OF THE FRENCHMAN'S CAP FROM THE COLUMBIA RIVER

GLACIAL ERRATIC NEAR HEADWATERS OF McCULLOCH CREEK

would go for nothing. However, our men seemed confident that an old trail up Mica Creek, north of Bigmouth River, would prove suitable for our purposes, and that our provisions could be made to hold out, so we finally decided to venture it.

Accordingly, on July 4 we dropped down into the torrid Columbia valley and continued northward on the "Big Bend Trail" through unbroken forest. Only occasionally did we catch glimpses of the heights. The evening of the sixth found us encamped at Mica Creek (100 miles from Revelstoke), so named on account of the millions of tiny mica flakes that sparkle in the water. Rain held us prisoners here for a week. So incessantly did it fall that we could scarcely stir from camp, and it began to look as though exhaustion of supplies would drive us back without further accomplishment. Curiously enough, we had no mosquitoes. Their rôle was taken by minute "sand-flies," whose attacks came without warning and against whose needle-like stings there seemed to be no defence. Finally, however, the storm moderated, and we forced our way up a disused trail to timber-line on the north side of the valley (5900 feet). From here in the course of five days of broken weather we managed to visit three commanding summits (7800–8300 feet) and to extend the plane-table work over most of the locality. We found that we were on the main axis of the Selkirk range and very near its northerly terminus.

The Big Bend, the most northerly point reached by the Columbia river, was in full view, a sweeping ox-bow of muddy water, whitened in places by rapids—and it gave us a thrill of satisfaction to realize that here at last was the fulfilment of a long-felt desire. Considered solely as scenery, the Bend might easily be held commonplace; certainly as we saw it under heavy skies it possessed little of the spectacular. To the physiographer, however, it constitutes a locality of unusual interest, for there two major features of the great cordillera make a junction: the Rocky Mountain trench and the Selkirk valley. These separate the Rocky Mountains, the Selkirks, and the Gold Range from one another.

The Rocky Mountain trench is one of the longest continuous depressions in the world, stretching no less than 800 miles in almost a straight line along the westerly base of these mountains. The Columbia river has its source in the trench at lat. 50° 15′, and occupies it for something less than 200 miles towards the north-west. At the junction of the Selkirk valley, however, the river bends abruptly into the latter and follows it southerly to the United States. The next 60 miles of the trench is occupied by Canoe River, which flows in exactly the opposite direction, thus meeting the Columbia head on, and, strangely enough, just at the latter's Bend. But this is not all. At almost the very point of confluence of the Columbia and Canoe still another river pours in its turgid stream. This is Wood River, draining the country about Athabasca Pass and Fortress Lake towards the north-east. Thus we have the somewhat extraordinary instance of three considerable rivers and three

considerable mountain systems all meeting at one place—the Big Bend.* It may be remarked in passing that the term "Big Bend," as commonly employed, is not to be taken literally, but as referring broadly to the whole vicinity and sometimes even to the entire northerly end of the Selkirk mountains which fill it.

As regards the mountains of the Big Bend region, it may be said at once that there are none of outstanding importance within a radius of 10 miles. In general, they lack distinctive form. They consist principally of long slightly fretted ridges from 8000 to 9000 feet high, spotted here and there with patches of snow and glaciers. Further off, however, loftier summits are to be found. East of Canoe River, and about 12 miles from the mouth, we noticed a fine rock dome with exceedingly steep sides. Our observations with the clinometer assigned it an altitude of 10,300 feet. Several other peaks near by were but little lower. In the Gold Range about the same distance away appeared a long row of rugged summits, striped with snow and glaciers. The highest—an impressive massif seen previously from Groundhog basin—is in the neighbourhood of 10,500 feet. From here to the northerly end of the range in the narrowing angle between the Canoe and North Thompson rivers, a distance of about 50 miles, many fine peaks and glaciers occur, but the country has hitherto been so inaccessible that practically nothing is known about them. The recent completion of the Canadian Northern Railway through Albreda Pass and the valley of the North Thomson River, however, will doubtless soon lead to their exploration, as the axis of elevation is much nearer that side and several alluring ice peaks are in full view of the passing trains.

In the Selkirks near us the elevations were lower. The loftiest peak of the final group of the range, a characterless dual-topped massif rising a few miles to the east, did not surpass 9000 feet, so we definitely settled that the region of high uplift in these mountains does not extend west of the valleys of the forks of Bigmouth River. Between these streams rose the fine snow mountain seen before, roughly pyramidal in shape and suggestive of a lion couchant. Its elevation is about 10,200 feet.† Facing it across the valley to the east stretches the Windy River range, a continuous even-topped wall, half a dozen miles long and 10,000 feet high, which serves as a pedestal for several attractive peaks that reach considerably higher. Next to the Adamant range, this is the most important group of the extreme northern Selkirks. As a whole it extends roughly from Kinbasket Lake to Mount Argonaut, a distance of 10 miles, although midway between the crest-line sags into what may turn

* See in this connection "The Nomenclature of the North American Cordillera," by R. A. Daly, *Geographical Journal*, vol. 27, pp. 586–696 (1906), with map.

† Since this was written the peak has been named by the Geographic Board of Canada "Mount Chapman," in honour of Major Robert H. Chapman, deceased.

out to be a timbered pass. The range is mantled with magnificent glaciers on both sides and would well repay exploration.

Having reached the end of our provisions, it now behoved us to turn our steps homewards. We would have liked to have crossed the range to Kinbasket Lake in order to examine the high peaks and glaciers in the Selkirks from that side, but the lack of food left no alternative. Accordingly on the eighteenth we started back, covering the 100 miles to Revelstoke in six days without halts. At Downie River we were tempted to make a raft and let the swift, smooth Columbia waft us comfortably to Revelstoke instead of plodding painfully along its banks on foot. But when we came to look around for the needful timber, we discovered that every tree which would have served our purpose had been used up years ago, and that we should have had to go miles and spend more time on the raft than it would take to walk.

In conclusion a few random observations may be presented. Goldstream is the largest easterly affluent of the Columbia north of Revelstoke. Downie River ranks next, and then Bigmouth. The other tributaries are small. A very interesting fall occurs in Goldstream a mile or two above its confluence with the Columbia. Being invisible from the trail and rather difficult to reach, it is practically unknown. The final leap of the water is some 70 feet, but including the cascades in the canyon above, the total drop is some 300 feet in a distance of perhaps a quarter of a mile. The unusual feature of the fall is the point of its occurrence. In the ordinary type of "hanging valley," the waterfall is always found very close to the point of junction of the lateral valley with the trunk valley. But in the case of Goldstream the fall is situated in the trunk valley itself several miles from the opening of the lateral valley. The structure is not due to subsidence, for a canyon extends below the fall for some distance towards the Columbia. Neither of the large streams similarly situated with respect to the Columbia—Bigmouth River and Downie River—has falls or even canyons near its mouth. On the face of it local uplift appears to be the explanation, for well-incised meanders occur in Goldstream for 15 miles above McCulloch Creek. It was regretted that time was lacking for study of this peculiar phenomenon.

Between Goldstream and Downie River the Columbia runs in a notch through the hills, and in this are to be found its worst rapids north of the United States boundary. For many years a hardy steamboat plied the treacherous currents north from Revelstoke to the foot of the rapids, but it never tempted fate beyond. A little hamlet called La Porte grew up at the terminus just above Downie River, and a good road leads thence to Goldstream, where the former mining activity centred.* The

* McCulloch Creek, a small tributary of Goldstream only 4 miles long, yielded $2700 in gold in 1865. In 1866 the yield was $100,000 as reported to the Gold Commissioner, but this is estimated to be no more than half the truth owing to the tax levied on export gold.

place is now deserted, but the name still lingers on most maps, masquerading in big type like a metropolis.

The rapids occur in a deep gorge which drives the road high up on the mountain side, so that at one point it is 500 feet above the river. The roaring of the water is plainly heard, but the rapids are invisible. The largest are Death and Priest rapids, both impassable to canoes at high water and hazardous at low. It is possible then, however, to let a boat down with a rope, while the boatman clambers along the rocky bank left uncovered by the shrunken river. Death rapids, on account of its deceptive situation, has been responsible for many a disaster. Coming downstream, the place is hidden by a bend in the canyon until within 100 feet of the brink, when of course it is too late to retreat. The fall is a dozen feet, with huge waves and broken water that extend 150 yards or more. In addition the river takes a zigzag course, which makes destruction doubly sure once within the vortex. Priest rapids lie less than a mile downstream, and though they have an equal amount of fall they present merely a straight run over boulders, and are not feared to the same degree.

Walter Moberly, in his 'Rocks and Rivers of British Columbia' (1882), states that the name "Death Rapids" arose from the following incident, which occurred in the days of the fur trade: "One of the Hudson Bay Company's boats was running the Columbia from 'The Boat Encampment' to Colville. They were always accustomed to take out the cargoes and passengers, and drop the boats with a line over the bad rapid known as the 'Dalle de Mort.' A person in the boat who did not know the river accused the crew of cowardice, and seizing the steering-oar, forced the boat into the river and swamped her, only one man ever being known to have escaped. After long wandering he reached Fort Colville in a half-insane state, and from his ravings it was feared he had been guilty of cannibalism."

Father De Smet, in his 'Oregon Missions,' gives a vivid description of his passage of the rapids on 10 May 1846, as follows: "Some hours of descent (from Boat Encampment) brought us to Martin's Rapid, where a Canadian of that name and his son were killed. The roar of the waters is dreadful, and the agitation resembles that of an ocean in a storm. The bed of the river is there sprinkled with enormous fragments of rock. Our Iroquois guide, a fearless and skilful pilot, shot the boat through the menacing breakers. Dancing and leaping from wave to wave and helped by ten oars, we passed the great rapid of the Columbia with the quickness of lightning. At sunset we found ourselves at the entrance to the 'Dalles of the Dead.' [Dalle is an old French word meaning 'a trough,' and the name is given by the Canadian voyageurs to all contracted running waters hemmed in by walls of rocks.] Here, in 1838, twelve unfortunate travellers were buried in the river. The waters are compressed between a series of perpendicular rocks, presenting innumer-

GOLD RANGE AND COLUMBIA RIVER FROM MOUTH OF MICA CREEK

MOUNT ARGONAUT FROM THE SOUTH: VALLEY OF BIGMOUTH RIVER ON LEFT

VALLEY OF DOWNIE RIVER

THE FALLS OF GOLDSTREAM

able crags, fissures, and cliffs, through which the Columbia leaps with irresistible impetuosity, forming as it dashes along frightful whirlpools, where every passing object is swallowed up and disappears. By means of two long ropes we dropped down our boat through the Dalles, and encamped for the night at its outlet."

AN OUTLINE OF MODERN EXPLORATION IN THE OASIS OF SIWA

W. Seymour Walker

IN 1797 an Englishman, John Browne, reached the Oasis of Siwa—the first European of modern times to accomplish such a feat. He was attempting the through journey to Darfur *viâ* Siwa, and after more than the customary share of those hardships which are the lot of the explorer, he succeeded. An account of his journey, written in an entertaining and discursive style, was published on his return to England. From a scientific point of view, his narrative is of little value, particularly as regards Siwa, for during his brief stay in the oasis he was a close prisoner, fortunate to escape with his life. His description of the village might have been written yesterday, except that in his time the old citadel was intact and there were no houses built on the open plain around its base. He was lucky enough to obtain a glimpse of the ruins of the Temple of Jupiter Ammon, and the most interesting pages of his book refer to this decayed relic of one of the most famous Oracles of the ancient world. At the time of his visit the temple was in a fair state of preservation, and a considerable portion of it was still intact, occupying a large ground area. At the moment, owing to the depredations of the Siwani, and, at a later period and on a larger scale, of the ex-Khedive Abbas Hilmi, the temple can hardly be said to be other than a very fragmentary ruin. It consists of nothing but a small piece of one wall and a number of fallen columns lying round about. The surrounding ground bears unmistakable traces of the temple foundations, and indicates the original size and former magnificence of the building.

Before proceeding to outline what has been accomplished by later explorers and the gaps which they have left for their successors to fill, it will be well to give some general description, necessarily brief, of the Oasis itself.

The Oasis of Siwa lies at the southern edge of the great plateau of Cyrenaica, in Lybian North Africa, 200 miles due south of Sollum on the Mediterranean, and nearly 400 miles west-south-west of Alexandria. Territorially, the oasis is in the Western Desert Province of Egypt, although the boundary between Tripoli and Egypt passes within a few miles of its western end. The oasis itself is 80 miles by 5, this area being made up of smaller oases, consisting in their turn of groves of

stunted palms and patches of scrub vegetation, except near the villages, where there is actual cultivation of the soil. Less than a quarter of the total area of the oasis is under cultivation, although there are many evidences that in historic times the cultivated area was much more extensive. Climatic conditions, the advancing sand-dunes from the south, drift sand, and the enormous quantity of salt on the floor of the oasis, are gradually encroaching on the little cultivation that exists.

There are two main villages—Siwa and Aghurmi. Both are built on the same plan, although Aghurmi is constructed on a much smaller scale and built on a high flat-topped rock.

Siwa village, with its population of 3000, originally presented the appearance of a citadel with a front unbroken but for its three entrances. One hundred and twenty feet above ground-level at its highest point, it is built in a succession of storeys or layers of rooms, the average number of such layers being eight. The interior of the town resembles a honeycomb. It is a labyrinth of dark corridors, narrow stairs, tortuous passages, and dim-lit rooms. Open spaces around the wells—there are only two in the interior of the town—provide the only means by which natural light may percolate into the inner and lower recesses of the village.

The actual town is built of salt *sabaka* and mud bricks, reinforced with split palm logs. In accordance with Mohammedan custom, the Siwani never repair. As a result of climatic encroachments and the observance of this custom, the higher portions of the outer walls of Siwa town are crumbling. The appearance of the structure is of crazy instability, while to scale its heights appears, at a first attempt, to be attended with some danger. In spite of its apparent frailty, the structure is in reality both strong and stable. Although of some antiquity, it is difficult to conjecture the age of the present town. From the little traditional evidence which I have succeeded in gathering on the subject, I have placed the present erection at from three to four hundred years old, assuming, of course, that Siwa as it now stands was either built on or over, or is an improvement on some previously existing citadel.

Aghurmi, with a population of 700, stands about three-quarters of a mile to the east of Siwa town. It is a much smaller village and does not contain so many storeys. The chief interest here lies in the remains of Egyptian buildings. Steindorff has concluded that the ruins of Aghurmi are those of the actual temple or chamber which housed the famous Oracle. There are fragments of walls and several well-constructed subterranean chambers, while in the centre of the village is a remarkably fine archway in a splendid state of preservation. It is difficult to make a thorough examination of these ruins, since the village is built over and above them: particularly so in the case of the walls and archway which have been incorporated in the modern dwellings. Another distinction between Siwa and Aghurmi is a difference in religious sect.

The inhabitants of the former are Senussi; those of the latter Medani. As a consequence the feeling between the two villages is intense.

The Siwani are Libyans, more commonly referred to as Berbers. The question of their descent and their place in the Hamitic scheme I have treated fully elsewhere.* Now that a comprehensive grammar and vocabulary of the Siwi language has been published, it will be possible, after due comparisons have been made, to classify with accuracy this remote people. There is evidence to prove that the oasis of Siwa was inhabited by the ancient Libyans four thousand years ago. It may also be assumed, with grounds for credence, that the oasis was occupied by the proto-Hamitic ancestors of the Libyans from the time when they first migrated into North Africa. Following this line of thought it is permissible to reason that the present Siwani are the direct descendants of this famous race. The natural isolation of the oasis, the physical barriers which surround it, and the complete isolation of its population, all tend to confirm such an argument. It remains to be seen whether their dialect will now assist in the elucidation of this fascinating problem.

As the seat of the Oracle of Ammon, the oasis was a famous object of pilgrimage during the time of the Egyptians, who have left many interesting remains of their influence. Alexander the Great visited Siwa, and it was the Oracle of Ammon which is said to have conferred on him the divinity which he assumed thereafter. At the time of the conquest of Egypt by Cambyses, a Persian host was dispatched from the Nile to carry out the destruction of Siwa and its oracle. The Persians never reached Siwa; nor did they return to the Nile. I do not know whether there are any historical grounds for credence in the Siwani legend that they perished miserably—victims of the desert—in the inhospitable depression of Farafra. The Roman conquest of Carthage and Cyrenaica eventually led to the permanent occupation of Siwa by that nation; and until the Vandal kingdom of North Africa in the fifth century, one may assume that they exercised a peaceful authority over the indigenous inhabitants of the oasis.

The Siwani of to-day are untrustworthy and treacherous, imbued with hatred of all outsiders, a feeling which is heartily reciprocated. Since the advent of Es Senussi and El Medani in the eighteenth century the Siwani have maintained a little more communication with the outside Bedawi. This intercourse, slight as it is, has opened up a certain amount of trade, and the Siwani now barter their dates and olives in exchange for blankets, tea, and sugar. In all other respects they are self-supporting.

I now return to my outline of the work of exploration commenced by John Browne. In 1827 Minutoli made extensive researches in Libya generally, and included Siwa in his travels. He left behind him valuable matter recording his observations, but his reports on Siwa are incomplete

* 'The Siwi Language.' By W. Seymour Walker. Published by Messrs. Kegan Paul, Trench, Trubner, Broadway House, Carter Lane, E.C.

and in some cases regrettably inaccurate. Considering the special and trying circumstances with which all would-be explorers of Siwa have had to contend—from the time of John Browne until the European War—such a result is only natural. When it is remembered that the Siwani have always been actively hostile, it reflects greatly on those who visited and wrote on Siwa that they were able to place on record as much as they did.

Minutoli was the first of Libyan students to attempt any solution of the linguistic problems of the oasis. He concluded that the current speech was Touareg, or a dialect of Touareg with slight local variations in pronunciation. It is interesting to observe at this point that practically every Libyan student who has come into contact with the Siwani has arrived at the same conclusion, which, as I have stated elsewhere, I consider to be erroneous.

Several visits to the oasis were made between those of Minutoli and the next of the great Libyan pioneers, but produced nothing further than narratives, which although interesting are of little scientific value.

The indefatigable Rohlfs, the greatest of all North African workers, visited Siwa in 1874. He accomplished much valuable work, mostly topographical, but only while labouring under great difficulties. A significant incident came under my personal notice. A Bedawi of the Aulad Suleiman, who resided at Ajedabia, and was on his way through Western Egypt to Mecca, showed me a gold watch which he informed me was looted by his father from a white man. From his description, and the make of the watch, I do not doubt that it was once the property of Rohlfs.

Even with Rohlfs, who has left behind him such a volume of information describing his work in North Africa, there is the same lack of continuity in his work on Siwa, the same gaps which make our whole stock of knowledge regarding the oasis so very patchy and incomplete.

In 1896 Prof. Steindorff, the eminent Egyptologist, made his journey from the Nile to Siwa. It is by far the most scientifically valuable of all existing records depicting the oasis in modern times. Steindorff's interest is mainly archæological, but his paper on the journey contains a mass of assorted matter dealing with all branches of research.

Captain C. V. Stanley, R.A.M.C., made a report on Siwa in 1911, which is both concise and accurate. It was published as a Blue Book by the Egyptian Government. It does not contain a wealth of detail, but taken in conjunction with the papers of Rohlfs and Steindorff, it completes the total of reliable knowledge available until recent developments. Among others who, prior to the Great War, had visited the oasis were Silva White, Jennings-Bramley, and Royle Bey.

During the Senussi campaign of 1915–16–17, when armoured-car patrols were used for the final suppression of the Sherif es Senussi at Girba near Siwa, a good many opportunities were afforded to military officers of the Service to gather valuable information, particularly ethno-

ENTRANCE TO THE OASIS BY THE MAQAHHIZ PASS

SIWA TOWN FROM THE NORTH

GENERAL VIEW OF SIWA VILLAGE

THE OASIS FROM THE TOP OF SIWA

THE SPRING OF TAMUSI

TYPICAL SIWANI HOUSE OF THE BETTER CLASS

logical. Captain C. H. Williams, M.C., and Captain A. S. Lindsay, M.B.E., M.C., and Dr. John Ball of the Survey of Egypt, made an extensive cartographical survey of the oasis and of the Western Desert Province generally; but I do not know that other advantage was taken of the many opportunities thus presented.

Our present knowledge is thus based on the records of Rohlfs, Steindorff, and Stanley; other accounts may be disregarded, since they cover ground already known and present no original matter. It should be remembered that there are many points on which these three authorities disagree. Having regard to the special conditions which have always attended any research work in Siwa, this is to be expected.

Geographically, the oasis is known; archæologically partially so. On its geology, Dr. John Ball has recorded in a short paper the impression he received during a brief visit in war time. With the exception of some short notes by the late Oric Bates (*Varia Africana*, vol. 2, Peabody Museum, Harvard), and a paper by Mohammed Abdullah Effendi (*Varia Africana*, vol. 1), the oasis is unexplored from an ethnographical point of view. Other branches of scientific research have not yet been dealt with.

The advent of the War affected Siwa in many ways. It brought it under the permanent administration of the British Protectorate and it impressed upon the Siwani the power of the European. It would not be correct to assume that the Siwani welcome us with open arms, but they have certainly subdued their hostility, which, however, is too deeply rooted to be successfully eradicated by a few years of contact with the despised unbeliever. The Senussi campaign was an unparalleled event in the modern history of the oasis, and seriously upset the placid existence of its inhabitants. In the first place, they beheld the sacred and infallible head of their religion routed. Apart from spiritual allegiance, their insular prejudices had always prevented them from incurring any affection for the Sherif, aud his downfall caused a serious readjustment of their mental and religious attitude towards him. The most important influence exerted by the campaign was undoubtedly the birth of a new idea regarding the Briton, and that was a feeling of respect, supported by the assured knowledge that in spite of the forces at his disposal, he had no intention or desire to do other than assist them in every way by just and kindly government. As the natural result of these new mental processes, the Siwani will probably, in the future, tolerate the scientist and explorer in a more kindly fashion than hitherto.

I have come to this conclusion after having made a careful study of the people, and I intend returning to the oasis shortly, to carry out an exhaustive scientific survey which shall cover the gaps left by previous workers and provide detailed record. It is an undertaking well within the capacity of one man, since the oasis is small and its population concentrated. In any case, it is time that a definite scientific study

should be made of the Siwani and the isolated spot in which they dwell, for from constant intermarriage, and the observance of certain peculiar and unnatural practices, they are gradually becoming extinct.

TWO EARLY MONUMENTS TO CAPTAIN COOK

Captain Lord Claud N. Hamilton, D.S.O.

ALTHOUGH the monument erected to Captain James Cook at Kealakekua Bay, Hawaii, is well known, little attention has been paid to two earlier memorials erected to the memory of the great circumnavigator, records which unless published and preserved are likely before long to be obliterated and forgotten. Of these, one—the earlier—is still standing, and in probably much the same condition as when originally erected. The other, equally interesting although more recent, has been destroyed by the ravages of time, though two of its original inscriptions have happily been preserved.

Upon a bold lava-strewn headland, some 2 miles distant from the spot where Captain Cook fell, is to be seen a small cairn of lava boulders upon which stands a roughly hewn pole, some 8 feet above the top of the stones, bearing a small board upon which is affixed a copper plate. The inscription reads:

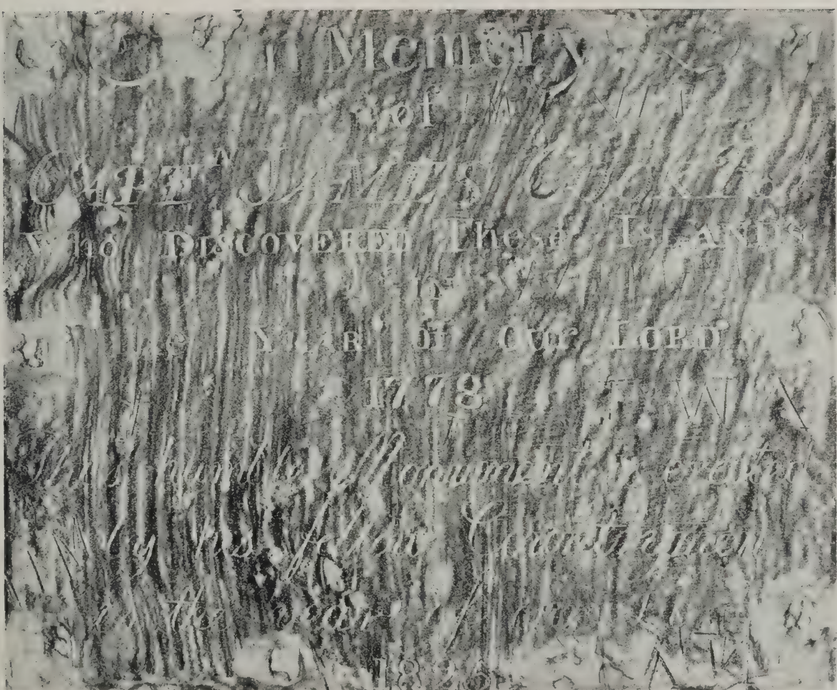
In Memory
of
CAPT^N JAMES COOK R.N.
Who DISCOVERED These ISLANDS
IN
The YEAR of Our LORD
1778
This humble Monument is erected
by his fellow Countrymen
in the Year of our Lord
1825

Fig. 1 is from a rubbing of the above writing.

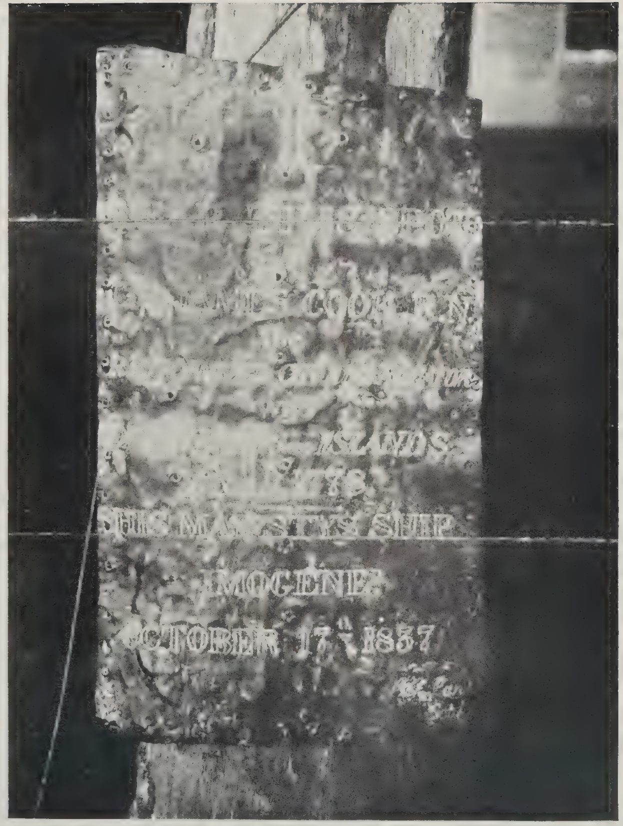
This, the earliest extant monument to Cook, is also probably the earliest attempt to perpetuate his memory. It is in an excellent state of preservation, due partly to favourable climatic conditions, but more largely to the durable quality of the wood used in its construction—ohia lehua (*Metrosideros polymorpha*).

This lonely cairn (Fig. 2) is situated some little distance from an abandoned road, in the middle of an almost impassable flow of the pahoehoe type of lava. It appears to be known to the older residents of

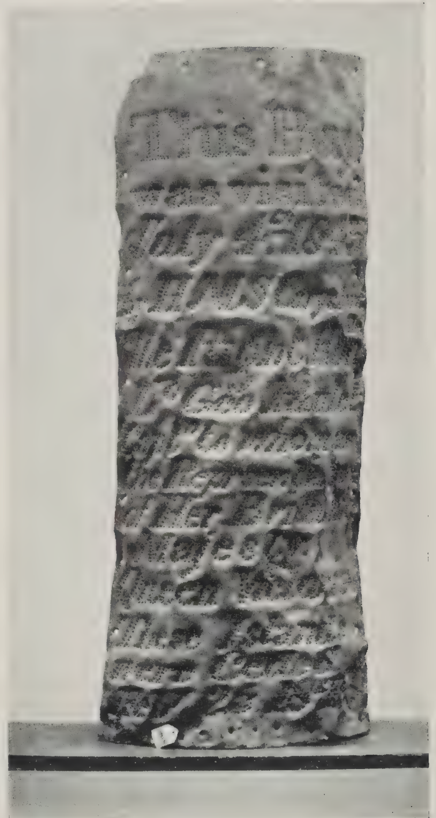
MONUMENT ERECTED BY CAPT. LORD BYRON, H.M.S. BLONDE, 1825



RUBBING OF THE COPPER PLATE ON THIS MONUMENT



PHOTOGRAPH OF THE FIRST PLATE ON THE MONUMENT ERECTED BY H.M.S. IMOGENE, 1837



PHOTOGRAPH OF THE PLATE ADDED TO THIS MONUMENT BY CAPT. LORD GEORGE PAULET, H.M.S. CARYSFORT, 1845

Kona, although it is so isolated and difficult of approach that little interest has been taken in it, and so far apparently no figure of it has been published.*

The second monument has not been so fortunate in its preservation, but the following information is sufficient to give it historic recognition and importance. It consisted of the stump of a coco-nut palm which grew on the identical spot of Cook's fall, bearing three inscriptions. Tradition reports the stump to have been that of a palm cut off by a ball from Cook's ship at the time of his death. It is further said that the top of the palm was taken to England by Captain Bruce of H.M.S. *Imogene*, who erected the first of the three inscriptions above alluded to.

The stump was erect in 1844 and in good preservation. At that time it was 5 feet in height, 1 foot in diameter at the top, and 2 at the base. The first inscription read:

> "Near this spot fell Cap^{tn} James Cook, R.N., the renowned circumnavigator, who discovered these islands A.D. 1778. His Majesty's Ship Imogene, October 17th, 1837."

The second inscription was as follows:

> "This sheet and coppering put on by the Sparrowhawk, September 16, 1839 in order to preserve the monument to the memory of Cook."

The third inscription read:

> "This Bay was visited *July* 4th 1843 *by HMS Carysfort The Right Hon L^{d} Geo Paulet Capt^{n} to whom as the Representative of Her Britannic Majesty Queen Victoria These Islands were Ceded Feb^{y}* 25 1843."

It is surmised that the original memorial consisted of the first inscription only, which was affixed to the coco-nut stump in 1837, the other two inscriptions being added in 1839 and 1843 respectively. In process of time the stump decayed and fell, carrying with it the inscriptions, which lay hidden in the sand of the beach. For many years the disintegrating bole was used by the natives as a resting-place for their canoes, until finally it rotted completely, and in this way the plates became again exposed to view.

Of the three inscriptions no record of preservation of the second, which is perhaps the least important, is known to the writer of these notes. The first was however appropriated by a native for the purpose of patching his canoe, and from him secured by a part-Hawaiian in whose family it is still believed to be, notwithstanding futile efforts by the authorities to secure its possession as an historic monument. An authentic photo-

* A brief reference to this monument is found in 'The Voyage of H.M.S. *Blonde* to the Sandwich Islands in the years 1824–1825' (London: John Murray, 1826). The Captain, Lord Byron, by this account, "erected a cross to the memory of Captain Cook on the spot where his body was burnt," and the above inscription is given.—Ed. *G.J.*

graph (Fig. 3) has however fortunately been secured of this valuable record. The original of the last inscription is preserved in the Bernice Pauahi Bishop Museum at Honolulu, and a photograph is shown in Fig. 4.

I am indebted for these photographs and notes to the kindness of Colonel L. G. Blackman of Honolulu, who gave them to me when I was in Honolulu recently during the voyage of the Prince of Wales.

THE PERMANENT COMMITTEE ON GEOGRAPHICAL NAMES

Major-General Lord Edward Gleichen, K.C.V.O., C.B., C.M.G., D.S.O.

NOW that the Permanent Committee on Geographical Place-names has been in existence for over eighteen months, some account of its constitution and work may prove of interest to readers of this *Journal.*

Most things have but small beginnings; and in this instance the hare was started, it is believed, through the Admiralty not being able to make up their minds as to what to call the place generally known as Walfisch Bay. It is indeed a hard nut to crack, there being at least three languages concerned in the matter.* Once the discussion had started, difficulties concerning the spelling of numerous other names cropped up; and finally the Admiralty suggested that the Royal Geographical Society should be invited to form a permanent Committee to deal with the question of geographical names, and that each Government Department should be represented thereon.

A preliminary conference of representatives of the Admiralty, War Office, India Office, Colonial Office, and R.G.S. was accordingly held at Lowther Lodge on 29 April 1919, and recommended the formation of a Committee (under the chairmanship of the writer), with the object of examining cases of doubtful geographical nomenclature and of eventually preparing, as required, authoritative lists of names for British official use. Mr. Hinks, secretary of the R.G.S., kindly consented to act as secretary for the time being, and has throughout given most valuable help. The Committee came into existence during the following month, with representatives from the Foreign Office, Board of Trade, Board of Agriculture, and Post Office, in addition to those already mentioned, and detailed a sub-committee to examine and report on the principles which should govern its work and on the best method of procedure. This task required a good deal of consideration and correspondence, and the taking of evidence from a number of experts in a variety of languages; but by the end of the year the sub-committee had reported, and had had its report approved by the Committee.

In order to get a definite basis to work on it was first of all necessary

* English, German, and Dutch, and perhaps Hottentot as well.

to draw up a series of "Rules for the Spelling of Geographical Names for British Official Use," together with a standard alphabet into which to translate all foreign sounds, this forming the "Table of Spelling and Pronunciation." The whole thing was termed the "R.G.S. II. system," and a copy of this is now attached to this article. It was not easy to draw up.

There has been a rather rough-and-ready system of spelling and pronunciation of foreign place-names more or less in use for the last fifty years or so. It is believed to have been originated in the middle years of the last century by Admiral John Washington,* but it was reshaped, tabulated, and published by the R.G.S. about 1865, and has consequently come to be known as the R.G.S. system. (It is on this system that the "R.G.S. II. system" has been based.) But, although sound and practical, the original rules have by no means been universally adopted by Great Britain; and there still flourish on British maps an overwhelming number of place-names which are spelled in a bewildering variety of ways. Some are spelled according to the broadest ideas of British pronunciation; others, with the best intention, are derived from hopelessly false etymologies; others again are wrong, obviously from a misunderstanding of the answers of the natives, or from mishearing the word, or being unable to convey its proper sound in writing; others again, with every intention of following the R.G.S. system, have gone wildly astray.

The old R.G.S. system had therefore to be very carefully overhauled, amended, and expanded; and the more the question was examined the more difficulty was there found in laying down comprehensive rules; for no sooner had a broad rule, carefully phrased, been formulated than numbers of exceptions, or variations in pronunciation, appeared as if by magic, all clamouring for settlement. What English word-examples, for instance, could be given as containing an *exact* rendering of the long and short "Italian" *a* and *o*? What sound should *j* represent so as to suit all languages? How were we to deal with the "neutral" or "indeterminate vowel"? How should the "liquid" sound of certain consonants be rendered in print? and so on, and so on. And with it all we had to restrict ourselves to the ordinary alphabet with no diacritical marks (or barely any); for if we once introduced these they would be most difficult to insert or read on crowded maps, most printers would not have the requisite type, and the various Post Offices would be driven to scratching their respective heads over them with great earnestness. But enough of our base-work: good or bad, it is here for the reader to digest at his ease.

One item which delayed us for long was the question of the *q*, whether it should find a place or not in R.G.S. II. system; and for a decision as to this we had first to investigate and lay down a scheme of Arabic transliteration, which involved a lengthy cross-examination of experts. This was fully described by the writer in the October 1920 number of this *Journal;* so this part of our task need not here be again referred to.

* A founder-member of the R.G.S., and its Secretary from 1836 to 1841.

In pursuing our investigations, however, we soon became convinced that a large majority of foreign names—especially European names in the "Latin" alphabet, with which, it must be remembered, we had bound ourselves not to interfere—would present considerable difficulties to the ordinary Briton as regards pronunciation. Who, for instance, would expect that the harmless-looking Polish town of Lodz should be pronounced more or less as Wudsh? or Qena as Enner? or the familiar Piraeus and Euboea as Pĭre-éfs and Évvia respectively? whilst the č's and ć's and å's and ş's and *oe*'s and suchlike called for urgent explanation. It was therefore determined to draw up pronunciation-tables of the alphabets of a large number of foreign languages, with explanations of their diacritical marks and other oddities. The talented Assistant to the Committee, Mr. J. H. Reynolds, set to work with a will and, with the help of the present writer and of some natives of the countries concerned, produced the alphabets of some thirty-two languages, which are now in the hands of the printer. These comprise not only every European language of any importance, including such near-by languages as Gaelic, Erse, Welsh, Icelandic, and Breton, but also several extra-European besides Arabic, such as Turki, Pashtu, Malay, Amharic, etc., etc.; and others are in course of preparation. These alphabets will (shortly, it is hoped) be published as No. 2 of the R.G.S. Technical Series, under the title of "Alphabets of Foreign Languages transcribed into the R.G.S. II. system."

As regards the drawing-up of lists of authoritative spellings, a beginning was made by provisionally deciding on about five hundred names commencing with the letters from A to F; but the alphabetical procedure was dropped for the time being in order to settle for good and all the spelling of a large number (about four hundred and fifty) of place-names in the Mandatory State of Tanganyika Territory (ex-German East Africa); for the Committee considered it of first-class importance to try and settle as soon as possible the spelling of names in a new territory before these had time to crystallize in wrong forms. These lists are now on the way out to East Africa for local official approval; and when they have been sanctioned they will be published. We are also dealing in similar fashion with names in the Cameroons and in Togo (some two hundred and fifty altogether).

Other important pieces of work accomplished have been the settlement of the spelling of numerous doubtful names (some four hundred) from all over the world submitted to us by certain authorities of the Historical Section of the War Cabinet, who desired to have our opinion in this connection on their work; and assisting other departments with the transliteration of maps.

The next task to tackle, when we have leisure, is the overhauling and correcting of a vast quantity of names in the forthcoming new edition of the R.G.S. map of "Eastern Turkey-in-Asia." This will involve a great deal of heavy spade-work.

Lists of the words decided on will be published as leaflets in the

Journal from time to time, and it is hoped to make a beginning in the next month or two with a list of the more common names which require an authoritative spelling laid down for them. It is readily acknowledged that we had hoped to do this before now; but the base-work required a great deal of very careful laying, more so than we expected. Added to this, it is not eazy to realize, without personal investigation, what a number of authorities, documentary, cartographical and otherwise, have to be consulted in order to decide definitely on the proper spelling of each place-name.

A definite beginning has thus been made, and as time goes on it is hoped largely to extend the usefulness of the P.C.G.N. It cannot unfortunately be expected that all map-makers and all writers will at once adopt our decisions: but we consider that as all our Government Departments have bound themselves to do so, it should only be a matter of time before the rest of the British-speaking world follows suit.

It would add to the interest of the Committee's work if readers would send them queries as to the spelling of names of which they are in doubt.* A few have already been received; but as they nearly all related to British place-names—which are already definitely laid down in the Ordnance Survey maps—the Committee was unable to give much assistance to these particular correspondents.

RULES FOR THE SPELLING OF GEOGRAPHICAL NAMES FOR BRITISH OFFICIAL USE.

(*Termed the* R.G.S. II. *system.*)

(1) The spelling of every place-name in an independent country or self-governing dominion using the Latin alphabet † shall be that adopted by the country or dominion, except in the case in

* Numbers of cards have been issued to the different Government Offices for this purpose, in the following form, which it is suggested might with advantage be followed by independent enquirers:

(Name)________________ desires a decision of the P.C.G.N. in the following case:

Name________________ Locality________________

Alternative names and statement of case:

____

____

Date____________ Signature________________

† Including "Latin" alphabets containing extra or modified letters, such as Serbo-Croatian, Polish, Rumanian, etc. The pronunciation of these letters is given in the 'Alphabets of Foreign Languages,' etc., mentioned above.

which certain important localities have also, in addition to the official name, another customary name, notably different, in which case the name customary in British use (*i.e.* "conventional") may be adopted (*e.g.* Geneva, Warsaw, etc., for Genève, Warszawa, etc.).

(2) The spelling of such place-names in colonial possessions as belong to languages coming under Rule (1) will be spelt in accordance with that rule.

(3) The accents and diacritical marks in official use by the above countries will be retained. Wherever it appears desirable, the pronunciation will be shown by giving the name as transliterated on the system below.

(4) All other place-names throughout the world will (with the exception of "Conventional" names and some others) be spelled in general accordance with the following system, which is based upon, and differs only slightly from, the system long used by the Royal Geographical Society, from which are derived the War Office system, 1906,* and the system of the Intelligence Division, Naval Staff, 1917.†

The broad features of this system are—

(*a*) That vowels are pronounced as in Italian and consonants as in English;

(*b*) That every letter is pronounced, and no redundant letters are used.

The system aims at giving a close approximation to the *local* pronunciation; but it is recognized that in some languages, notably Russian, Greek, and Arabic, the necessity for letter-for-letter transliteration often renders this impossible.

TABLE OF SPELLING AND PRONUNCIATION R.G.S. II.

a	Long and short, as in *lāvă*	Somāli, Bokhāră.‡
ä	As in *fat;* rare except in Teutonic languages.	
ai §	The sound of the two Italian vowels; frequently slurred over, almost as in Eng. *aisle*, *ice* ...	Wadai; Shanghai.
au	The two Italian vowels; frequently slurred, almost as *ou* in *out*	Sakau; Bauchi.
aw	When followed by a consonant, or when terminal, as in *awl*, *law*	Dawna, Saginaw.
b	As in English.	

* 'Rules for the Transliteration of Place-names occurring on Foreign Maps.' Compiled in the Topographical Section, General Staff, by Alexander Knox, B.A., Map Curator. 1906.

† 'Instructions for the Spelling of Place-names in Foreign Countries.' Naval Staff Intelligence Division. 1917.

‡ The long and short symbols given here are merely for explanation, not for use.

§ Pronounced differently in Greek: see 'Alphabets of Foreign Languages transcribed into the R.G.S. II. system' (to be published by the Royal Geographical Society).

c	Not to be used, but always replaced by *k* or *s*; except in the compound *ch*, and in many conventionally-spelt words, as	Kandahar, Seram. Calcutta, Celébes.
ch	As in *church;* never *tch* or *tsch* for this sound	Chad, Naroch.
d *	As in English.	
dh	Soft *th* as in *they;* a slight *d* sound sometimes preceding it in Semitic languages	Dhuvu; Riyadh.
e †	Long as in *eh?*; short as in *bet*. (For the *e* sound in the French *je*, see note at end on the "neutral vowel")	Gēlo; Mafĕking.‡
ei †	The two Italian vowels, frequently slurred ...	Beirut, Raheita.
(eu)	Not used as a single sound.	
f	As in English; *ph* must not be used for this sound (except in Greek; see *ph*)	Mustafa, Haifong.
g	Hard, as in *get, gift;* never as in *gem, gin* ...	Gedáref, Gilgit.
gh	Soft guttural, the Arabic *ghain* (غ)	Dagh, Baghdad.
h	Used only when sounded; or in the compounds *ch, dh, gh, kh, sh, th, zh*	Ahmadabad, Vrh.
i	Long as in *marine;* short as in *piano*	Fījī; Kĭbonde.‡
j	As in English; except in transliteration of Russian, Serbian (Cyrillic Script), Bulgarian, and Chinese, where it equals *zh*, or the French *j* §	Juba, Ujiji (Eng. *j*); but Jitómir, Pojega, Jelezna, Jao-ping (Fr. *j*).
k	As in English: hard *c* should never be used (except in conventionally-spelt words)—thus, not Corea, but	Korea.
kh	Hard aspirated guttural, as in the Scottish *loch* (not as in *lock*)	Khan, Sebkha.
l * / m / n *	As in English.	
ng	Has three separate sounds, as in *engrave*, *finger*, and *singer*. If necessary to distinguish, a hyphen may be placed, as in *en-grave*, *sing-er*	In-gássana; Bongo; Ng-ami, Tong-a.
o	Long as in *both* ‖; short as in *rotund*	Angōla, Kigōma; Angŏra, Hŏnŏlulu.‡
ö	As in German; equals the French *eu* in *peu;* or nearly the English sound in *fur*	Gömle, Yeniköi.
oi †	The Italian vowels: sometimes slurred as in *oil*. If necessary for pronunciation, a hyphen may be inserted.	Hanoi.

* See note at end on *Liquid sounds*.

† Pronounced differently in Greek: see 'Alphabets of Foreign Languages transcribed into the R.G.S. II. system' (to be published by the Royal Geographical Society).

‡ The long and short symbols given here are merely for explanation, not for use.

§ This decision has been arrived at chiefly owing to the large number of English maps of these countries in which the *zh* sound appears as *j*.

‖ The true Italian *ō* is broader than this: almost as in *broth*.

ou *	Dissyllabic, and not as French or English *ou*.	Zlatoust.
ow	Represents, as a diphthong, nearly the *au* sound (above) *only* in the romanization of Chinese. Conventional.	Hankow.
p	As in English.	
ph	As in *loophole;* not to be used for the *f*-sound, except in Greek	Chemulpho; Paphos.
q	Represents *only* the Arabic Qaf (ق): *i.e.* a guttural *k*	Qena, Iraq.
qu	Should never be employed to represent the sound of *kw*: thus, not Namaqua, Quorra, but	Namakwa, Kworra.
r	As in English; should be distinctly pronounced.	
s	As English ss in *boss*, not as in *these* or *pleasure*.	
sh, t †	As in English.	
th	Hard *th* as in *thick*, not as in *this*	Tharmida.
tth	The first *t* pronounced separately from the *th*, as in *at the.*	
u *	Long as in *rude*, or as *oo* in *boot;* short as in *pull*	Zūlū; Rŭanda.‡
u	Represents the French *u*, as in *tu* (Fr.) ...	Üsküb.
v, w, x	As in English.	
y *	Always a consonant, as in *yard;* it should not be used as a terminal vowel, *e* or *i* being substituted; *e.g.* not Kwaly or Wady, but ...	Kikuyu, Maya. Kwale, Wadi.
z	As in English *gaze*, not as in *azure.*	
zh	As the *s* in *treasure*, the *z* in *azure*, or the French *j* in *je;* but for the sound in Russian, Serbian, Bulgarian, and Chinese use *j* (*vide* note above under *j*)	Zhob, Azhdaha.
	The doubling of a vowel or a consonant is only necessary when there is a distinct repetition of the single sound, and should otherwise be avoided	Nuuhia, Oosima, Jidda, Muhammad.
	Accents should not generally be employed; but in order to indicate or emphasize the stress, an acute accent may be used ...	Saráwak, Qántara, Tong-atábu, Paraná.
	A long or short mark over a vowel (*e.g.* ā, ŏ) should only be used (and that sparingly) when without it there would be danger of mispronunciation	Kūt, Hashīn.
	Hyphens will not be used except to indicate pronunciation	Mus-hil.

Liquid Sounds.—The occasional "liquid" or "palatalized" sound of *d*, *l*, *n*, *t* (as in d'you, lure, new, tune) is as a rule sufficiently represented by a

* Pronounced differently in Greek: see 'Alphabets of Foreign Languages,' etc.

† See note at end on *Liquid sounds*.

‡ The long and short symbols given here are merely for explanation, not for use.

following *y*; where, however, owing to a following consonant, or to the letter in question coming at the end of a word, the *y* is inapplicable, the liquid sound will be represented by an apostrophe, thus: *d'*, *l'*, *n'*, *t'*.

The "Neutral Vowel."—The "indeterminate" or "neutral" vowel sound (*er*), i.e. the sound of *a* in *marine*, *e* in *often*, *i* in *stir*, *io* in *nation*, *o* in *connect*, *ou* in *curious*, *u* in *difficult*, etc., *e* in French *je*, or the often unwritten vowel (˝ *Fat-ha*,) in Arabic, etc., is represented as a rule by *a*: as in Basra, Hawiya; but sometimes by *e*, when the sound approximates more to *e* than to *a*: as Meshed, El Gezira.

(In any guide to pronunciation issued by the Permanent Committee on Geographical Names, the "neutral vowel" is represented generally by the italic *e*: occasionally also by italic *a* or *u*.)

This sound must not be confused with *e-mute*, where the *e* is not sounded at all: as in Abbeville.

EDWARD GLEICHEN, Major-General,
Chairman, P.C.G.N.

December 1920.

THE BELGIAN-GERMAN BOUNDARY DEMARCATION

THE definition of the new boundaries of Germany in the Treaty of Versailles begins as follows:

PART II. BOUNDARIES OF GERMANY.

ARTICLE 27.

The boundaries of Germany will be determined as follows:

1. *With Belgium.*

From the point common to the three frontiers of Belgium, Holland, and Germany and in a southerly direction:

the north-eastern boundary of the former territory of Neutral Moresnet, then the eastern boundary of the Kreis of Eupen, then the frontier between Belgium and the Kreis of Montjoie, then the north-eastern and eastern boundary of the Kreis of Malmédy to its junction with the frontier of Luxemburg.

This brief delimitation of the boundary now to be discussed is slightly amplified by four articles in Political Clauses for Europe: Section 1. Belgium.

ARTICLE 32.

Germany recognizes the full sovereignty of Belgium over the whole of the contested territory of Moresnet (called Moresnet neutre).

ARTICLE 33.

Germany renounces in favour of Belgium all rights and title over the territory of Prussian Moresnet situated on the west of the road from Liége to Aix-la-Chapelle; the road will belong to Belgium where it bounds this territory.

ARTICLE 34.

Germany renounces in favour of Belgium all rights and title over the territory comprising the whole of the Kreise of Eupen and of Malmédy.

During the six months after the coming into force of this Treaty, registers will be opened by the Belgian authorities at Eupen and Malmédy in which the inhabitants of the above territory will be entitled to record in writing a desire to see the whole or part of it remain under German sovereignty.

The results of this public expression of opinion will be communicated by the Belgian Government to the League of Nations, and Belgium undertakes to accept the decision of the League.

ARTICLE 35.

A commission of seven persons, five of whom will be appointed by the principal Allied and Associated Powers, one by Germany and one by Belgium, will be set up fifteen days after the coming into force of the present Treaty to settle on the spot the new frontier line between Belgium and Germany, taking into account the economic factors and the means of communication.

Decisions will be taken by a majority and will be binding on the parties concerned.

The above delimitation is a characteristic example of the impossibility of following the geographical definitions on the general map attached to the Treaty: a reproduction of the Europe 1/1,000,000 over-printed in red by the Service géographique de l'Armée.

The territory of neutral Moresnet is a small very acute triangle which contains what was once a valuable zinc-mine. Owing to some difficulties in the first delimitation in the boundaries of Belgium, the details of which are exceedingly obscure, this small territory remained neutral ground administered by officials appointed alternately by Belgium and Germany. The apex of the triangle is at the three-boundary point of Holland, Belgium, and Germany up to 1914. The eastern boundary runs almost exactly south from this point until it strikes the road from Aix-la-Chapelle to Liége, where it turns south-west along the road and passes through the straggling township named Prussian Moresnet to the east, and neutral Moresnet to the west of the road, there being a third Moresnet a little further to the west in Belgium. The northern apex of the triangle is on a col over which runs the road from Gemmenich to Aix-la-Chapelle, and below which runs in a tunnel the railway to the same city that lies just south of the Dutch border. Owing to the breaking of boundary symbols to show this road and tunnel, it is only just possible to discover on the 1/100,000 map (and for clear understanding requires the 1/25,000) that the boundary of the Kreis of Eupen leaves the boundary of neutral Moresnet a few hundred metres south of the three-boundary point. The Treaty phrase "the north-eastern boundary of the former territory of neutral Moresnet" refers therefore to a few hundred metres of that

boundary only just distinguishable on a large-scale map. The boundary as delimited then circumscribes the Kreis of Eupen and returns to the 1914 boundary. The next section, "the frontier between Belgium and the Kreis of Montjoie," is again only about 500 metres long, south of which the new boundary strikes east once more round the Kreis of Malmédy till it meets the northern extremity of Luxemburg.

The boundary thus delimited approaches Aachen within 4 kilometres and actually includes some establishments, apparently Workhouse Infirmaries, belonging to the town, as well as the districts from which the town derives the principal part of its water supply. It includes the important station of Herbesthal on the main line to Cologne, and the famous camp of Elsenborn of which we heard so much in the first days of the war. The railway communications of the district are extensive and peculiar, having been devised for the launching of a great offensive across the Belgian boundary, and it was realised in drafting the Treaty that the boundary might need some modification, which could be determined only after study on the ground. It was therefore provided by Article 35 that the Boundary Commission should take into account the economic factors and the means of communication :—a latitude not given to any other Boundary Commission provided by the Treaty. Certain others are allowed to take into account the economic and geographical conditions of the locality, but there is not elsewhere any mention of means of communication.

It is important to notice that the Treaty of Versailles does not contain the provision which is found in all the later Treaties: "They shall have the power, not only of fixing those portions which are defined as a line to be fixed on the ground, but also, where a request to that effect is made by one of the states concerned, and the Commission is satisfied that it is desirable to do so, of revising portions defined by administrative boundaries; this shall not however apply in the case of international frontiers existing in August 1914, where the task of the Commission will confine itself to the re-establishment of signposts and boundary marks." Had it been otherwise the Commissioners would have been tied to the half-kilometre of the old boundary west of Montjoie, and it would have been impossible to consider the modification foreseen in drafting the Treaty.

The Treaty came into force on 10 January 1920, and the Boundary Commission was immediately appointed as follows: France, Lieut.-Colonel Jean Tilho, who was chosen President; Great Britain, Colonel G. F. A. Whitlock, R.E.; Italy, Lieut.-Colonel Pellissone; Japan, Lieut.-Colonel Ousami; Belgium, Lieut.-Colonel Maury; and Germany, Herr Heimann. The Commission was left one short by the failure of the United States to ratify, or join in the execution of the Treaty.

The Fellows of our Society who had the pleasure of hearing Colonel Tilho lecture on January 19 will remember how nearly the coming into

force of the Treaty prevented that lecture. The visit was with some difficulty fitted in between the appointment of the Commission and the preliminary series of meetings which began in Paris on January 22. After a preliminary decision that Article 35 gave power to make variations even of considerable extent if necessity required, the seat of the Commission was transferred to Liége and the question was studied on the ground. The railway in question is a main line from Aachen to Luxembourg, and that is naturally how it is viewed by the Germans, though its importance as such must be diminished by Article 40, wherein Germany renounces all rights to the exploitation of the railways of Luxembourg. From the point of view of Belgium it is essential to the economic life of her new eastern territory. The railway cuts into the Kreis of Eupen east of Raeren, and emerges to approach the boundary very closely at Petersgensfeld, whence after a long excursion east it comes south through Montjoie and enters the Kreis of Malmédy at Kalterherberg. The country between it and the Belgian boundary is mostly forest and of no great economic value, but contains several considerable villages of German nationality along the railway at Roetgen, Lammersdorf, and Mützenich, a suburb of Montjoie, whose inhabitants addressed to a Commission impassioned appeals for the retention of German nationality, both for themselves and for their railway. The decision could not have been easy, for no one could deny that variation of the Treaty boundary to give to Belgium 28 kilometres of railway and a considerable piece of the Kreis of Montjoie was possible only under a somewhat broad interpretation of the Commissioners' powers. But after a prolonged examination of technical evidence the Commissioners allotted the whole line to Belgium. On the German Government refusing to accept the decision, it was referred to the Conference of Ambassadors at Paris, who now exercise many of the powers of the Supreme Council, including the task of seeing that the Treaty is executed.

Pending decision on this principal point, the Commissioners were able during the course of the summer to complete the boundary from Luxembourg to Kalterherberg, with certain adjustments made by mutual consent of Germany and Belgium. The three-boundary point of Belgium, Germany, and Luxembourg, which is a river junction, was fixed with the co-operation of Luxembourg, and all this southern section of the boundary is now marked with stone pillars.

While things have thus progressed favourably in the south, there has been a long and unexpected delay over the railway questions. The Treaty provided that all questions in dispute should be settled by a majority of Commissioners, but the decision of this majority on the cession of the Montjoie railway was rejected by the German Government as contrary to the Treaty and beyond the powers of the Commission. The Commissioners, they declared, had made a new boundary instead of demarcating that of the Treaty; they had advanced the boundary 9

kilometres, giving Belgium 28 kilometres of railway, 5 stations, 7500 hectares of land, and 2000 German inhabitants. "Compared with the territory ceded by the Peace Treaty this is not demarcation, but annexation." After long and careful consideration the Conference of Ambassadors decided that the Commissioners had acted in accordance with the spirit and letter of the Treaty, and within the limits of their powers. The Belgians had undertaken to cede the sources of the water supply of Aachen and to make enclaves where there was any considerable German population west of the railway. The Conference of Ambassadors adopted this solution in principle and remitted it to the Boundary Commission with instructions to refer back to the Conference if great modifications were required. On July 15 the Commissioners were able to report that the settlement appeared to them satisfactory, and on the 22nd the Conference approved the Report of the Commission and gave instructions that the demarcation of the boundary should proceed.

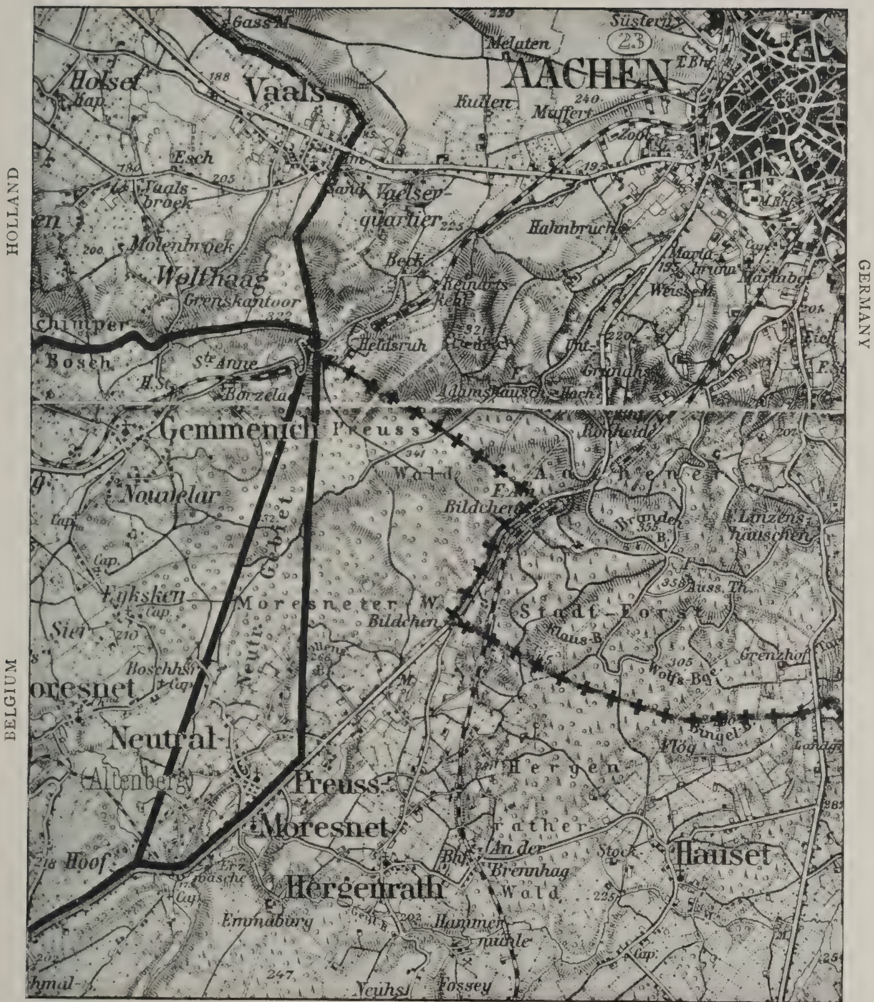
Nevertheless the German Government have continued to protest, and on the ground that considerable variations of the Treaty are now permitted, have put in a claim for the frontier station of Herbesthal with the railway to Aachen and all the part of Eupen north of the railway. At the time of writing (early in December) this claim is still undecided, and the documents in the case have grown to formidable dimensions. On the German side it is contended that a large frontier station for the Customs control of passengers and goods is essential to smooth working of future International traffic, and that there is absolutely no room for the construction of such a station either at Aachen or between it and the new boundary. On the Belgian side it is claimed with much force, first, that as Germany has destroyed the Belgian frontier station of Wolkenraedt, she must be content to lose Herbesthal in exchange; and secondly, that the principal traffic for the future would go by the new line which Germany had constructed during the war from Aachen through Visé to Tongres, so that Herbesthal has become of secondary importance. It is difficult to study the question impartially after seeing the destruction wrought by the Germans in Belgium, and also because the somewhat compensating construction of brand-new railways is not yet shown upon any maps accessible to us.

If it should be thought that the proceedings of the Boundary Commission on this relatively short boundary have been unduly prolonged, one must remember that a large part of the delay is due to the admission to the Conference of Ambassadors of a German protest against the decision of a majority of the Commissioners. Once such a right of protest is allowed delay becomes inevitable, and the power of rapid progress under the terms of the Treaty is very largely lost. The principle of the Treaty was clear, that the interested Commissioners should settle the matter between them when they could, and that any dispute should be decided by the non-interested Commissioners, acting as a kind of court of appeal. It

must in any case be difficult to prevent the waste of time involved by calling for expert evidence and report, if one side or the other is bent on delay; but it appears to the writer that if there has, as a matter of fact, been any avoidable delay on the part of the Commissioners in demarcating this boundary, it is due very largely to the curious fact that neither Belgium nor Germany has appointed for its Commissioner a man who can give his whole time to the business. One is a Professor in the École Militaire, Brussels, the other is now the Landrath of Cologne; so that the Commissioners of the non-interested Powers, with no other duties than to finish the matter as quickly as possible, have found progress barred by the inability of the interested Commissioners to meet.

By the courtesy of the Boundary Commissioners, and especially of the President, Colonel Tilho, and the British Commissioner, Colonel Whitlock, the writer has been allowed to see something of the operations on the southern section of the boundary in the Kreis of Malmédy. The boundary of the Kreis is as intricate as a parish boundary in England, and it was very inadequately marked upon the ground by the Germans: not nearly so well as most parish boundaries in England. Since the boundaries of the Kreis follow the boundaries of communes, and the boundaries of communes the cadastral boundaries of private property, there are along some sections of the Kreis boundary a good number of unworked and slightly buried cadastral stones which local knowledge can identify as property boundaries. The points common to three communes are usually marked by a worked stone pillar, and there are therefore occasional pillars of this kind along the boundary of the Kreis, but there are no other points marked, even for example where the Kreis boundary crosses the main road, and the work of the technical sections of the Commission was in its early stages an inquiry into the tracks of communal boundaries, assisted by the unpublished cadastral plans, and by the knowledge of local inhabitants, which is generally good. But the task of marking this complex Kreis boundary with the rigour required by International Boundary Commissions has been very laborious, since it is necessary to carry out the whole with cadastral accuracy; otherwise a private owner might find the fringes of his property in the wrong country. The twelve hundred or so boundary pillars must therefore be placed in such a way that every important turn of the boundary is correct in position within a few centimetres.

The triangulation points of the German trigonometrical survey are well preserved and the numerical data in excellent order. But the country is covered with plantations, many of them young, which have grown up since the survey was made, and the intervisibility of the points is now very bad. Moreover, the country is intersected with deep wooded valleys from the bottoms of which it is quite impossible to see the trig. points, and a great deal of subsidiary triangulation has been required to achieve the end of getting a trig. point close to the boundary every kilometre or two.



Kreis of Eupen

The territory of NEUTRAL MORESNET and the northern part of the Kreis of EUPEN. The old international boundaries are shown by solid line: the new boundary as delimited in the Treaty of Versailles by line of crosses: drawn on enlargement to 1/75,000 (appr.) of the *Karte des Deutschen Reiches*, 1/100,000.

Kreis of Malmédy

The Kreise of EUPEN, MONTJOIE, and part of MALMÉDY, enlarged to 1/350,000 (appr.) from Vogel's *Karte des Deutschen Reiches*. The old international boundary shown by the ribbon of colour which has photographed black: The new boundary delimited in the Treaty of Versailles shown by line of crosses added to boundary symbol of the Kreise.

The necessary triangulation has been executed in duplicate by the German and Belgian sub-Commissioners, the latter using 5- and 4-inch micrometer theodolites of English make, giving an average triangular error of only eleven seconds of arc, so that the standard of accuracy is nearer that of secondary than tertiary triangulation.

When the trig. points have been fixed, a traverse is carried along the boundary, and the places of the boundary pillars determined by offsets. A good deal of cutting is necessary in Malmédy to carry this traverse within convenient distance of the pillars, and without much more extensive cutting it will not be possible to ensure the fulfilment of the general conditions that the successive pillars shall be intervisible. Probably the Belgian and German Governments will find it necessary to provide by supplementary conventions for clearing and keeping clear the line where it passes through these very thick woods.

For the measure of the traverse lines in this rough and steep country the survey parties have used an instrument which we have not seen before described—a 5-metre bar with chisel ends fitted with a kind of clinometer divided to read the amount in centimetres to be subtracted from the length of the bar in order to give the horizontal component. This can be used on slopes as steep as 45°, and does not require nearly so much clearing as would be needed if a tape were used. The Belgian assistant Commissioner, Commandant van Bleyenberghe, speaks well of the performance of this instrument, which is worth consideration for tropical survey.

When the traverses are closed upon the trig. points the rectangular co-ordinates of each boundary pillar are to be calculated on the conformal projection of Gauss (the transverse Mercator) with origin the point of intersection with the equator of the meridian 23° 40′ east of Ferro, and with Bessel's figure of the Earth. This computation is being carried out in Berlin by the staff of the Landesaufnahme, and control calculations are executed in Brussels on the same projection, but with Clarke's figure of 1866, so that the differences will be considerable but will vary smoothly. The retention of the purely fictitious meridian of Ferro is an interesting archaism in a twentieth-century boundary; the origin on the equator is still more difficult to understand; and the whole operation provides one more illustration of the need for some general agreement on a figure of the Earth.

The boundary stones are generally square pillars of a dark grey basalt with coarse grain, inscribed on opposite faces with the letters B and D; they are set without any concrete foundation over a small clay drain-pipe sunk in the ground vertically, and their whole appearance is exceedingly modest.

It was natural to inquire how far such a conventional boundary is likely to make a satisfactory international boundary, and whether it would not have been better to make some attempt at a boundary with more

relation to the topography. The answer seems to be that the people of a German Kreis had a very strong sense of corporate feeling, probably stronger than that in an English county. There was a strong local administration in the person of the Landrath, and the boundaries of the Kreis were clearly recognized in practice though so imperfectly marked. This historical unity would make it less of a dislocation for the whole Kreis to be transferred from one nation to another than if some more geographical and less traditional line had been taken. If this opinion is right one may hope that the settlement will give more satisfaction to local feeling than a boundary more in accordance with geographical or strategic considerations.

The Kreis of Malmédy is a beautiful country of the Eifel, familiar to visitors to Spa: a deeply dissected plateau well forested with oak and conifers, and with large stretches of heather and broom. There is not much cultivation, a certain amount of pasture in the valley bottoms, excellent trout fishing, and comparatively few inhabitants. The timber of its forests will be some compensation to Belgium for the destruction caused by the invader in the Belgian forests across the old boundary further north. The neighbourhood of Spa itself was preserved as a domain of imperial headquarters, and the palatial concrete dug-out of the Imperial War Lord in this rather secluded spot will long be a source of amusement to the neighbourhood.

By all accounts the camp of Elsenborn which figured so largely in the accounts of German preparations for war had not really the importance attributed to it. It was an extensive training ground, but it did not hold more than about one Division, and it was not in the least adapted for a great concentration centre. The greater part of its area is included in the Kreis of Malmédy, and the remainder, which was in the Kreis of Montjoie, has been ceded by the German Commissioners in exchange for that part of the Forest of Bullingen which lay in Malmédy. The Belgian army has obtained a good training ground, and the great advantage of a broad zone of difficult country on its eastern frontier.

The new boundary is so far removed from what would be considered on geographical grounds a good natural boundary, that one would be tempted to think it unsuitable for its high purpose, did it not very much resemble the old boundary, whose character led in the past to no particular difficulties. There is, however, one feature of the new which may be thought likely to lead to trouble: along considerable stretches the boundary is formed by a road, or rather by the ditch on one side of the road. In uncivilized countries such an arrangement has been found unworkable, owing to the ease of desertion from caravans; in civilized countries one would probably have to think more of the ease with which parcels of contraband might be thrown over the hedge from a fast car; but as neither side, either here or on the boundary of Czecho-Slovakia and Poland appears to have raised this objection, one must suppose that

it is not so dangerous as it seems. Much would evidently depend on the local convention as to right of frontier Customs patrols to cross when necessary the actual boundary line.

If one may draw provisional conclusions from a visit to this still uncompleted boundary, they are these: that it is generally unwise to attempt any considerable diversion of the Treaty line by giving large scope to the Boundary Commissioners under the terms of a clause which is intended to imply what it does not say in plain language: that to define a new boundary in the terms of the existing Kreise is sound in respect to popular feeling, but that a more geographical boundary, especially the watershed, would have avoided most of the difficult questions of water supply and danger of contamination that have been raised in the course of this work; but that the enormous complications which would have thus arisen from the division of private properties renders any such geographical advantage impossible, and that the Kreis or commune boundary is the only feasible solution.

One final point deserves mention, the provision of Article 34 that during the six months after the coming into force of the Treaty registers should be opened by the Belgian authorities at Eupen and Malmédy, in which the inhabitants of the territory should be entitled to record in writing a desire to see the whole or part of it remain under German sovereignty. This does not constitute the two Kreise a Plebiscite area, though we have seen it so marked in recent atlases. It is not a Plebiscite because the vote is not secret, because the vote is to be exercised only by people of a certain opinion, and not by those of the opposite opinion, and because the vote is not taken in communes but in registers at only two principal towns. During the six months in which the registers were open less than 250 people recorded a desire to remain German, and the League of Nations by its Council has already decided that this insignificant expression of popular feeling gives no reason for interfering with the provisions of the Treaty. A. R. H.

HANDBOOKS OF THE GEOGRAPHICAL SECTION, NAVAL INTELLIGENCE DIVISION, ADMIRALTY

A SERIES of some fifty handbooks and manuals of various countries, produced during the Great War, have now been put on sale to the public, and it is hoped that the material which they contain will be found of scientific value and also of use to commercial firms and visitors to the countries with which they deal or as a foundation for articles in Encyclopedia and guide books. The origin of this series was briefly as follows :—

On the outbreak of war it was found that the Admiralty, War Office, and other Government Departments required much geographical information not readily accessible concerning areas likely to be directly or indirectly involved in naval or military operations.

In 1915 the Geographical Section of the War Office was fully employed in he production of maps, and neither that department nor the Foreign Office had a personnel available for such necessary books. It was therefore decided that, on behalf of all Government Departments, a special geographical section should be added to the Naval Intelligence Division of the Naval Staff—with the active collaboration of the geographical section of the General Staff, Military Intelligence Department of the War Office, and the War Trade Intelligence Department which was established by the Foreign Office—which should supply the requirements of the War Cabinet. For this purpose, Dr. H. N. Dickson, Prof. of Geography at University College, Reading, undertook to organize a staff to collect and sift material available and compile books and reports of the kind required, and to produce the necessary maps. The whole series was printed at the Oxford University Press. The standard handbooks contain chapters on :

Physical features and boundaries ; climate ; history ; administration ; inhabitants ; religions ; trade and finance ; hygiene and social conditions ; economics, flora and fauna ; communications ; gazetteer ; vocabularies ; index and maps.

The relative importance of the various chapters differs considerably with the country, and the quality of the information available was very variable. In very few cases has a second edition been produced in which errors in the first could be corrected. The date of the compilation therefore merely gives the knowledge available to the compilers at the time of production, and as the geographical section of the Naval Intelligence Division was demobilized in July 1919, some unfinished volumes were passed for press without the revision that their authors would have expected. In some cases, where the work was not sufficiently advanced to justify its completion, it was abandoned and the material handed over to the department most concerned. In others, the chapters already at the printers' were completed, without finishing the work to the standard set, it being thought more advisable to issue the work already done in this form than that the labours of the compiler should be lost.

In addition to the larger Handbooks and Manuals, short Geographical Reports were compiled on special areas. Parts of these were incorporated in the Handbooks prepared by the Historical Section of the Foreign Office for the use of the Peace Conference, and have now been issued for general information. The volumes available to the public represent only a moiety of the books produced ; other volumes contain military information or confidential information patriotically placed at the disposal of the Government for the purposes of the war, on the understanding that it should not be made public. It has therefore been necessary to retain their confidential character, and such books are only available for official use in Government Offices.

The work of the Geographical Section was begun in July 1915, some rooms and the collections of the Royal Geographical Society being placed at Admiralty disposal for the purpose. As the personnel of the Geographical Section of the Naval Intelligence Division increased it was transferred in April 1917 to Hertford House, and again in September 1918 to 41, Berkeley Square, where it remained until the section was demobilized on 28 July 1919.

It is not the practice in official publications to give the names of authors, and in any case it would be invidious to attempt to place in order of merit the many distinguished professors and students who have assisted in this work. The Lords Commissioners of the Admiralty have presented a complete set of these works to the Council of the Royal Geographical Society. T. D.

REVIEWS

EUROPE

The Life of Horace Benedict de Saussure.— Douglas W. Freshfield, D.C.L., with the collaboration of **Henry F. Montagnier.** London: Edward Arnold. 1920. Octavo. *Price* 25*s. net.*

MR. FRESHFIELD and his collaborator are to be congratulated on the conclusion of a labour of love that has lasted over several years, and the people of Geneva should feel themselves fortunate that one of their most eminent citizens, who during more than a century had wanted a biographer, should have found at last such sympathetic treatment by the pen of an Englishman working on the researches of an American in the archives of the family and the city. The work published but a few weeks ago requires the mature consideration which we hope to give it later; but there need be no delay in commending it to the widest circle of readers, who may find themselves forgetting the scientific in the human interest of the subject, and sometimes losing de Saussure himself in the delightful pictures of life in Geneva and travel both on the Continent and in England, which Mr. Freshfield's skilful pen has drawn for our instruction and amusement. Those who turn first to the somewhat specialized interests of the Alpine climber, the physicist, the geologist, or the educationalist, will not be disappointed in the full and detailed treatment of these sides of de Saussure's life; while the reader of wider tastes will find unexpected pleasure in the sometimes fantastic characters of his contemporaries, in the polished and occasionally cutting correspondence with his acquaintances; and above all in the happily turned phrases and rarely mischievous comments of the biographer, who has been especially happy in disinterring little amusing, mildly scandalous stories about Sir Joseph Banks and others of our countrymen who were friends of de Saussure. His letters are rendered in such spirited English that it is sometimes hard to remember that they were not written in that language. Their gaiety, and terseness, and humour makes them seem more modern than the eighteenth century, were it not that the writer showed himself a true man of that century in his usual indifference to the beauty of the scenery in which he worked. A critical appreciation of the book as the biography of a famous scientific man we must leave to a later occasion; but welcome it at once for its breadth of knowledge and remarkable interest.

Peterborough.— K. E. and **R. E. Roberts.** London: S.P.C.K. 1920. Pp. 128. 4*s. net.*

This volume is one of "The Story of English Towns" series; but it makes no attempt to give the story of the city of Peterborough. It is a careful and loving description of the abbey and cathedral church round which the town grew. Railways and industries are dismissed in a page and a half. The book is antiquarian and architectural and has no geographical interest. The three diagrams which appear as End Papers are clear and legible, and so mark a welcome advance on some which have appeared in earlier volumes of the series, though they are still without scales. C. B. F.

The Evolution of a Coast-line: Barrow to Aberystwith and the Isle of Man.— William Ashton. London: Edward Stanford. 1920. 10*s. net.*

This is the record of very long and detailed investigations, both on the actual coast-line named and on ancient records and maps, into the changes that have taken place during historic times. Contrary to the generally accepted view, the author holds that from Morecambe Bay southwards the changes of the coast have been due in large measure to continuous subsidence, and much

of the evidence which he brings forward appears to support that view. His conclusions deserve, and will doubtless receive, critical examination at the hands of local geologists and antiquaries, but whether they are confirmed or not, the author is to be congratulated on a prolonged and patient piece of research, the occupation, as he tells us, of many hours "stolen from a much-crowded business life." The book suffers, like much good amateur work, from defects in arrangement, and in particular it opens with a series of quite unnecessary stumbling-blocks that may prejudice the instructed reader against it, viz. (1) an inversion of the lines of a famous quotation from Tennyson, (2) an index which precedes the preface, and (3) an introductory chapter which starts with the nebular theory and proceeds to a tabulated "Geological Record" full of inaccuracies. The real matter of the book hardly begins until chapter viii., and at least the first four chapters may well be skipped. The book is illustrated by a large number of maps and some photographs and reproductions of old views. A. M. D.

Discovery in Greek Lands.— F. H. Marshall. Cambridge: University Press. 1920. *8s. 6d.*

This little book is a sketch of the archæological discoveries that have been made in the eastern Mediterranean region during the last fifty years. As it is printed in good-sized type and extends to little more than a hundred pages, the sketch is necessarily a very brief one. Just a third of the work is devoted to the prehistoric period, in which attention is more particularly devoted to excavations in Crete, at Mycenæ, Hissarlik, Argos, and Sparta. The Historic period, divided into two sections, an earlier and a later, is illustrated by discoveries at Athens and Corinth, Tegea, Mantinea, and Megalopolis in Greece, at Miletus, Ephesus, Pergamon, Priene, and Sardes in Asia, at Naukratis, and Daphne in Egypt. A chapter is given to temple sites, among which are those at Thermos, Epidauros, Argos, Ephesus; the very interesting one dedicated to Asklepios, the god of healing, on the island of Kos; and, by far the largest yet discovered (and, if Herodotus is to be trusted, the largest ever known), the temple of Hera on Samos. In an interesting but too brief a chapter Delphi, Olympia, and Delos as centres of Greek life are described. Finally, an account is given of some isolated discoveries, the most striking being the remarkable sarcophagi decorated with reliefs, such as those known as Alexander's and *Les Pleureuses*, found in subterranean chambers at Sidon.

The author has certainly made the most of the very short space at his disposal, and has illustrated his descriptions with photographs of sites, sculpture, and pottery. Many of these are commendable, but some are not so clear as might be wished. It is to be feared that the general reader, for whom the author avowedly writes, may experience some difficulty in visualizing and realizing a good deal of the architecture described in so brief and condensed a form. A useful bibliography is added, which might very well have included *Reale Academia dei Lincei*, *Monumenti antichi*, La Grange's *La Crète Ancienne*, Tsountas–Mannatt's *The Mycenean Age*, and Fürtwängler's *Mykenischen Vasen.* E. A. P.

AMERICA

A Handbook of St. Kitts-Nevis.— K. J. Burdon. Published by authority of the Government of St. Kitts-Nevis by the Crown Agents for the Colonies. 1920. Pp. 247 and viii. *Illustrations and Maps.*

This little handbook, compiled by the wife of the administrator of the presidency of St. Kitts, Nevis, and Anguilla, gives a great deal of authoritative

information about these little-visited islands. Even if the volume is not geographical, it contains the raw materials of geography. A separate map, revised to date, on a scale of half an inch to a mile, is devoted to each of the islands. They are produced by the G.S.G.S., War Office. The historical chapters are fairly full, and there are useful notes on the geology, fauna and flora, besides much miscellaneous information. Some of the zoological terminology should be revised. The classification of whales among fish, frogs among reptiles, and beetles and centipedes among mammals is unfortunate. The only meteorological statistics are a few annual means. These are small matters which can easily be corrected in a future edition : the volume as a whole bears evidence of careful work.

MATHEMATICAL AND PHYSICAL GEOGRAPHY

Meteorology. A Text-Book of the Weather, the Causes of its Changes and Weather Forecasting, for the Student and General Reader.— Willis Isbister Milham, Ph. D., Field Memorial Professor of Astronomy in Williams College. New York : The Macmillan Co. 1918. Pp. vii., 549. *Maps and Illustrations. Price* 21*s*.

The writing of a text-book on a rapidly expanding subject like meteorology must be a somewhat ungrateful task, because no sooner is the book published than it begins to get out of date. With this necessary limitation the present work may be looked upon as fairly complete. The plan is attractive and consistent, but the rather large number of charts of average and particular conditions in the United States, useful as they are, would be more appropriate in a book dealing with the climatology of that country than in a general text-book. A somewhat novel but praiseworthy feature is a chapter on "Floods and River-Stages," a subject not often discussed in a 'Meteorology,' although appertaining to meteorology, hydrology, and geology alike. It is a little curious in the chapter on the "Pressure and Circulation of the Atmosphere" to find a perfectly lucid explanation of the balance between the wind and pressure gradient nowhere symbolized, as in nearly every other work, by the well-known type of formula : $\gamma = 2\omega\rho V \sin \lambda \pm \frac{V^2\rho \cot r}{R}$, where γ is the pressure gradient, ω the Earth's angular velocity, ρ the density of the air, V the velocity of the wind, λ the latitude of the place of observation, r the radius of curvature of the path of the wind, and R the radius of the Earth.

More care should be exercised in discriminating between generalizations applicable to a single region and those applicable to a larger portion of the Earth's surface. For instance, nearly all American works emphasize the point that severe thunderstorms are associated with cyclonic areas of low pressure, and on p. 326 of the present work we read, "Nearly all thundershowers which occur in extra-tropical regions are to be found in the southern quadrant of a Low." But this hardly tallies with common experience in England, where, as a rule, the more violent summer thunderstorms are bred, not in definite cyclonic systems, but in the stagnant conditions associated with complex and irregular distributions of barometric pressure. In the British Isles anything in the nature of definite cyclonic circulation in summer means a cool, windy, Atlantic type of weather, which is unfavourable to the surface heating by solar action that is such a potent cause of thunderstorm instability. In the lower latitude of the States, where the summers are very hot, cyclonic conditions do appear to be specially conducive to thunderstorms and tornadoes. In connection with thunderstorms some interesting figures are quoted showing the

average number per million of lightning fatalities a year in different countries. Thus in England 1 person in a million is killed annually: in France, 3; Sweden, 3; the United States, 6; Prussia, 6; and Hungary, 16. The last affords a bright statistical side-light on the notorious character of electrical storms in the Carpathian mountains and Danubian plains.

In the chapter on "Climate" the distinction between weather and climate, and between meteorology and climatology, is not very philosophically drawn; but the author avoids the common confusion between a *factor* of climate in the causative sense, and a constituent *element* of climate. Thus on p. 429 he says: "It is sometimes stated that the type of storm, the amount of rainfall, the direction of the prevailing winds, etc., are the factors which determine climate. This would seem to be a mistake, as it is these which constitute climate." Finally, a word of protest may be raised against the consideration of cyclonic and anticyclonic circulation under the heading of "Secondary Circulation of the Atmosphere" (chapter vi.). If it is necessary to retain the term "secondary" circulation at all, it should surely be kept for purely local systems of air movement. Cyclones and anticyclones ought to be regarded as playing an essential part in the "primary" circulation, for they constitute the actual method by which this is brought about. L. C. W. B.

Introductory Meteorology.— Prepared and issued under the auspices of the Division of Geology and Geography, National Research Council. New Haven: Yale University Press. 1918. Pp. xii., 149. *Illustrations and Maps. Price 4s. 6d. net.*

The origin of this work, as stated in the Preface, was the war-time need of providing army officers with meteorological instruction, but its usefulness will prove much wider than that of fulfilling the function of a military text-book. As it had to be prepared in a very short time with the collaboration of several authors, the book to some extent lacks unity of plan. Chapter vii. on "Atmospheric Optics" is well presented, and the subject of the rainbow is handled in a much more interesting manner than usual, whilst the usual simplified, generalized explanation of a complex phenomenon is at the same time omitted. A useful diagram on p. 6 shows the composition of the atmosphere at different levels, and it is instructive to know that whereas at sea-level, where the average pressure is 760 mm., the percentage of hydrogen is only 0·01 per cent., at a height of 140 kilometres, where the pressure is reduced to 0·444 mm., the percentage of that gas is estimated to be 99·15 per cent. An adiabatic diagram on p. 33, after Neuhoff, is valuable, giving the rate of change of temperature of air changing level both when dry and when saturated. On the other hand a diagram on p. 99, representing circulation between hot and cold water-tanks by way of introduction to the study of atmospheric circulation, cannot be said to represent, except in the most rudimentary fashion, any type of convectional movement that takes place in the free atmosphere. In a section of the work dealing with cloud-heights (p. 88), the atmosphere is divided into levels of maximum and minimum cloudiness; but it is not probable that the particular levels specified would be generally agreed to, and in any case the subject requires closer study with the aid of aeronautical meteorologists. We are told on p. 122, in a chapter on weather forecasting, that the "weather for any time and place depends almost wholly on the pressure distribution that obtains for that time and place." This statement requires some qualification inasmuch as it sometimes happens that very similar pressure distributions on two occasions are accompanied by widely different weather.

The general state of the weather depends, also, on the temperature and humidity of the air currents which may be partly independent of the pressure distribution, although these factors interact to some extent with the pressure conditions. On pp. 81 and 82 the nocturnal radiation fogs of river valleys are discussed as "summer fogs." Though such fogs may be summer rather than winter phenomena in the United States, they are very definitely winter occurrences in the damp northern climate of the British Isles. There seems to be a typographical error on p. 70, where, in the explanation of the diurnal range of pressure, "a forced *afternoon* compression of the atmosphere" ought apparently to read "morning." L. C. W. B.

GENERAL

Influence of the Great War upon Shipping.— J. Russell Smith. New York: Oxford University Press. 1919. Pp. x. + 357. 6*s*. 6*d*. *net.*

This book is one of the Preliminary Economic Studies of the War prepared and published under the auspices of the Carnegie Endowment for International Peace. It was written in 1918, during the war and under the handicap of war-time restrictions on publication of certain information. Hence large parts of the book will require revision and extension when we can have fuller access to information and see the facts in a truer perspective. The chapters likely to be of most interest and importance now are: I. "The Organization of World Shipping before the Great War;" V. on "Government Aid to Shipping" in all the important maritime states; and XI. "Shipping Policy after the Great War." Chapter i. gives a lucid account of the liners, and groups of lines and "conferences," in their relations to various classes of traffic and to the tramp steamers. Here the author has a note on the coal export of Britain, which he regards as "a kind of by-product of the tramp steamer traffic" (p. 7); but his statement that "Rather than fruitless ballast, any owner would choose to take coal at less than cost" (p. 6) is open to question. Coal taken at less than cost would be ballast, and would probably be carried only in ballast quantities, whereas it was, in fact, taken in full cargoes. The discussion serves to emphasize the great importance of export coal to British oversea trade, since it enables Britain, in normal times, to fill the holds of outgoing as well as incoming tramps, and so obtain lower freight rates than if one voyage was made in ballast.

In chapter xi. Prof. Smith writes of possible developments after the war. We are still in the period of reconstruction which he predicted, in which shipping policies are largely undecided; but since we are, unfortunately, still far from having attained freedom from fear of war, it is safe to say that shipping will not be left to the free play of competition. Each important maritime state will take steps to maintain, under its own flag, such a minimum amount of shipping as its government decides is necessary. It is difficult to resist the author's conclusion that a policy of state-aided shipping, if developed by the leading Powers on a large scale, may end by driving privately owned trading ships off the seas and greatly increasing the waste involved in voyages made by empty ships. In his concluding chapter the author gives a clear statement of the fact that the world is now an economic unit, made so by the trade developed in the last hundred years. The day when any people could be self-sufficing is gone. It can only return if modern civilization is broken up and men thrown back to the isolation, poverty, and lower standards of living of the past. Prof. Smith is optimist enough to assert, "In 1787 the United States was virtually thirteen independent commonwealths, and the physical and intellectual task of

making the people of those thirteen governments function as one government in 1789 had greater difficulties than the task of making the United States of the world out of the ten leading Powers in 1920" (p. 345). This ignores the existence of differences of language, traditions of hostility, memories of war and oppressions, jingo nationalisms, and such differences of government as those between the sacred, paternal, autocratic monarchy of Japan and a democratic republic. America had none of these difficulties. In spite of the greater ease of physical communications to-day, it is safe to say that such difficulties as these will postpone the appearance of the United States of the World for a considerable time. C. B. F.

Geography of Commerce and Industry.— R. S. Bridge. London : Hodder & Stoughton. 1920. Pp. viii. + 264. 4*s*. 6*d*. *net*.

This book is one of the widely advertised "New Teaching Series." It is built up on the plan of regarding the world as the economic unit, and dealing with specific countries or regions in relation to that unit: in doing so it rightly emphasizes the vital importance of transport and the great trade routes. It is an unfortunate result of the form in which trade statistics are collected and published that such works as this are almost compelled to give more attention to foreign trade than to trade within a customs boundary, although for nearly all countries the internal trade is in fact much greater than the external. Yet on p. 328 the author writes that "Exports are the main thing, as always."

While the plan of the work is excellent, the execution leaves much to be desired. The diagrams are not numbered, nor is there any list of them. On p. 217 the author speaks of "a rough diagram . . . ; it need not be drawn to scale." The few which are given certainly accord with this view. They are rough and inaccurate. The diagram of ports of the U.S.A. on p. 218 is altogether misleading as to relative positions and distances—*e.g.* Chicago-Duluth (*ca.* 400 miles) is shown equal to New York-Washington (*ca.* 220 miles) —while that of the N.E.R. on p. 121 is simply grotesque. Diagrams, however rough, should be accurate, or they are worse than useless. The text, in too many places, shows a similar neglect of accuracy. In discussing the influence of climate on crops (ch. iii.) no distinction is made between annual and perennial plants: the list of railways serving the port of Hull (p. 91) omits the N.E.R. and the L. & Y.R. : on p. 119 the Durham and Northumberland coal-field is put down as two distinct industrial centres ; and the mileage of the N.E.R., which the author takes as his type of railway system, was 1734 in 1911, not 493, as stated in the table on p. 117. Some of the errors may be misprints, but they are so numerous as to destroy the value of the work, in spite of the excellence of its general plan. It is to be hoped that it will be submitted to a complete revision and correction by a competent geographer at any early date, and so be made into a really useful work. C. B. F.

Human Geography: The World.— J. Fairgrieve and **E. Young.** London : Geo Philip & Son. 1920. Pp. 224. 3*s*. *net*.

This book is an introductory survey for young children. Its order of presentation is not logical but "psychological," and this sometimes leads to a mixing of facts which produces a misleading impression, as in chapter iii., where facts relating to the Forest and Grassland peoples are attributed, without discrimination, to the Indians of the Plains. The book is interestingly written, and will probably appeal to the children for whom it is designed ; but first impressions should be based on clear statements of facts. C. B. F.

George, Third Earl of Cumberland, his Life and his Voyages.— Dr. G. C. Williamson. Cambridge University Press. 1920. *Price 25s. net.*

Dr. Williamson has been fortunate enough to have access to a great deal of fresh material in private archives relating to the Earl of Cumberland. And it is material of great historical value, including many letters of Lord and Lady Cumberland and the account of his voyages prepared for his daughter, Lady Anne, Countess of Dorset. It has made possible a far more complete account of his life than we have yet had, and gives us new views of his character and work. Lord Cumberland was an interesting man, typical in many respects of the Elizabethan age, versatile, adventurous, ambitious—courtier, commander, and, as seen in his letter to Lady Warwick relating to the West Indian expedition of 1598, statesman too. Cecil writes of "his spirit which loves action," and Lady Cumberland, in a pathetic letter, tells us that "his desires were still on great things." He was one of those noblemen, of whom there have been many in the history of British expansion, who lavished their private fortunes in oversea enterprises—piracy, conquest, trade, colonization—partly for private gain, partly from public spirit. In the full record of his life which Dr. Williamson has been able to put together from the new documents, we can trace his development from a "mere privateer" to a statesman of the type and school of Raleigh, designing the overthrow of Spain's maritime power and the transfer of her rich colonial trade to England. The majority of the twelve voyages which he organized, though not all of which he made himself, seem mere piratical expeditions off the Spanish coast, to Sierra Leone, Brazil, Fazal, the West Indies. "Their design is upon the King (of Spain's) treasure." On the fifth voyage his ships assisted in the capture of the Portuguese carrack, the *Madre de Dios*, a rich prize laden with pepper, pearls, amber, and musk, booty that it was difficult to divide peacefully. For the ninth he built a ship which Purchas describes as "the best ship that ever before had been built by any subject." But the twelfth voyage was the most important of all. This was the expedition to Porto Rico, a town supposed impregnable, "the very key of the Indies, which locketh and shutteth all the gold and silver in the continent of America and Brasilia." The town was taken, but owing to severe illness amongst his men, Cumberland was forced to evacuate it. The prominent position held by the Earl in the military and commercial activities of Elizabeth's reign is shown best in this expedition of 1598, and in his part in the foundation of the East India Company.

An important feature of Dr. Williamson's biography is the correspondence of Lady Cumberland, which gives us the reverse side of this activity—the woman's point of view on British expansion. We may quote a passage from the moving account of her own life given in the fragment of a letter reproduced: "In this mean time my Lord grew to acquaint himself with pleasant delights of Court and exchang'd his country pleasures, with new thoughts of greater worlds. So home I came with my two sons, to Skipton, leaving my Lord at Court, where interchangeably he lost with many goings back and forwards and turnings, many for the worse, but few for the better, till we had wasted our land and substance, which in hope of better fortune of the sea than we had of the land, he ventured many thousands, which we saw come empty home."

The book contains some good illustrations, and, though not well written, is very interesting for the new material given, and is an important contribution to Elizabethan biography.

E. A. B.

Historical Geography of Britain and the British Empire. Book I.— **Thomas Franklin, A C.P., A.R.S.G.S.** Edinburgh : W. & A. K. Johnston, Ltd. [1920.] *Price 2s. net.*

This first volume of Mr. Franklin's 'Historical Geography of the British Empire' deals with the history of the British Isles and the British Empire down to 1815; the second volume is to continue the story to the present time. With 260 pages, including twenty maps, it is at two shillings a very cheap book, for its narrative is clear and readable and the matter well arranged. In general the author's method has been to describe the geography and then to sketch the history, but his treatment is fuller with the later centuries, and there is more interweaving of geographical considerations with the historical narrative when he deals with British expansion. The amount of attention given to the growth of the Empire, and particularly to India, is a special feature of the book, and probably the reason for taking so late a date as 1815 as the line of division between the two volumes, which seems rather to overcrowd the first volume. The account of the regulation of colonial trade on p. 185 is too brief for its purpose. A further explanation of the old colonial system ought to have been given. On p. 185, too, 1521 is clearly a misprint. On the whole the book is well done, and will be very useful for the school teaching of the history of the British Empire. E. A. B.

The Expansion of the Anglo-Saxon Nations.— Edited by **H. Clive Barnard, M.A., B.Litt.** London : A. & C. Black. 1920. *Price 7s. 6d. net.*

In this book the story of the British Empire is told from the point of view of its various members, each of the chapters on the history of the Dominions being contributed by a native of the country described. The idea is a good one, both because the nature of colonial history is probably better understood in the colonies than in the mother country, and because the emphasis naturally falls on the national development of each colony rather than on the imperial policy, and a fresh point of view is given to the English reader. The book also includes a sketch of the history of the United States and of British India, and thus gives a comprehensive account of the new nations of Anglo-Saxon origin that have sprung up in divers parts of the world, and of the general character of British oversea expansion. On the whole the work is well done, and the book will be very useful for the upper forms of schools. A readable text-book of our imperial history, giving a brief account too of American development, has long been much needed. But there is some lack of proportion in the treatment, for Canada receives more space than the United States, and, to take a smaller example, four pages are devoted to the reasons why Newfoundland has not joined the Dominion, and not as many lines to the similar case of New Zealand and the Commonwealth. Perhaps this accounts for the Canadian chapter appearing the best. That on the United States is too summary on the more recent history of the country, and the Australian chapter rather ignores the interesting political development of some of the Australian colonies. It seems a pity, too, that the history of the smaller possessions could not have been worked into its place in the general narrative instead of being arranged catalogue fashion at the end. On the last page the editor seems to ignore the fact that British New Guinea has long been administered by the Commonwealth. The book contains many useful maps, a chronological table, and other tables (from one of which we learn that an American has little chance of becoming President of the United States unless he is either a lawyer or an "educator"), a bibliography, and an index. It is cheap, and should be very useful. E. A. B.

THE MONTHLY RECORD

EUROPE

The Boundaries of Wiltshire.

THE subject of county boundaries—both external and internal—their evolution and changes in the course of history, is an intricate one, on which little information is easily accessible. For one English county—Wiltshire—the whole history both of the county and local administrative boundaries from 1832 to 1918 is usefully summarized in a recent paper written jointly by Lord Fitzmaurice, late Chairman of the Wilts County Council, and Mr. L. Bown, Clerk of the same, its publication being suggested by the passing of the Representation of the People Act, 1918. The paper is printed by George Philip & Son and contains four maps showing respectively the Ancient Hundreds in 1832, the Highway Districts under the order of 1864, the Poor Law Unions and Sanitary Districts as they stood in 1878, and the Administrative areas as fixed by the Act of 1918. At some remote pre-Norman time Wiltshire was cut out of the ancient kingdom of Wessex to form a subordinate administrative area or "shire." In the reign of William the Conqueror certain "Yardlands" on the borders of the New Forest were transferred from Hampshire to Wilts, but from this time to 1832 there is no evidence of any change in the area of the county. In 1832 it was still divided into "Hundreds," each containing a number of parishes, many of them scattered about in small detached pieces and sometimes situated in more than one county. Detached blocks of Wiltshire were embedded in Berks and Gloucester and in one case a detached block of Gloucester was surrounded by Wilts, but had a detached portion of the latter within it. By the Reform Act of 1832 such detached areas were, with certain exceptions, merged in the counties surrounding them. The subsequent subdivision of the county for various administrative purposes—Highway Districts (by the Acts of 1862 and 1864), Poor Law Unions, Rural Sanitary Districts, and so on—produced a confused tangle of jurisdictions which could with difficulty be set out even on a large-scale map. Not only were they unrelated among themselves, but some, *e.g.* the Poor Law Unions, overlapped the County Boundary. Many Wiltshire parishes, on the other hand, were attached to administrative areas having their centres in other counties. The new Highway Act of 1878 encouraged the re-modelling of the Rural Highway Districts in greater accord with the Rural Sanitary Districts, and in 1882 a new Divided Parishes Act did away with most of such parishes and gave power also to alter the county boundary. A Boundary Committee was formed in Wiltshire, and among other measures for the removal of inconsistencies secured the restoration to Wiltshire of parishes which had previously been under outside jurisdiction; these measures proved of great value in connection with the Redistribution of Seats Act, 1885. The Local Government Act of 1888 at last provided an easy process for the alteration of county boundaries, of which advantage was taken by Wiltshire to negotiate transfer of parishes with neighbouring counties. In 1894 the Rural Sanitary Districts became the areas of the new Rural Councils, and the Highway District was abolished. But all this did not affect the position as regards political representation, so that the anomaly of non-coincident boundaries still remained. Finally, in 1918, the political divisions were for the first time based, as they should have been in 1885, on administrative areas. The county is now divided into 13 boroughs and urban districts, and 19 rural districts; and contains 327 parishes.

The "Sea-mills" of Argostoli, Cephalonia.

A recent writer in the daily press has called attention to the "unsolved mystery" presented by the phenomenon of streams of salt water running inland from the sea in the island of Cephalonia, and he suggests that it is time that scientific men should turn their attention to this strange phenomenon. This seems to imply that he is unaware of the amount of discussion already devoted to these underground rivers of salt water, which, as is well known, have for a number of years been harnessed by man as a motive power for water-mills. Not only have they attracted attention from casual visitors to Cephalonia, but have been the subject of careful study by scientific writers for more than half a century. Among these the names of Mousson (1859), Fouqué (1867), Wiebel (1873), Issel (1895), and Simonelli (1901) deserve special mention. Partsch too, in his monograph on "Kephallenia und Ithaka" published in 1900 as *Ergänzungsheft* 98 to *Petermanns Mitteilungen*, stated the main elements of the problem and discussed the attempted solutions of his predecessors, but ended by supposing that a complete solution could probably never be arrived at. The most valuable description of the phenomenon is perhaps that of Simonelli, put before the Fourth Italian Geographical Congress in 1901 (*Atti*, pp. 170 *seq.*); this writer gives in detail the results of his own examination of the locality, besides summarizing the views of his predecessors. Both at the new and old mills he took observations of the levels, temperature, and salinity of the water, fully confirming the statements as to the amount of salt water engulfed. At the old mill the volume proved to be about half a cubic metre or over 17½ cubic feet per second. Some of the explanations put forward have connected the phenomenon with the presence of salt springs on the shores of the gulf of Argostoli, and in the hope of testing the correctness of this view Prof. Simonelli made an experiment with colouring matter thrown in at the inlet of the salt water, but the quantity at his disposal (4 kilogr. of uranine) was perhaps too small to give very decided results. A search in boats in the neighbourhood of the various springs gave negative results, but on returning the next day to the mill itself, the professor found to his surprise the sea-water in its immediate neighbourhood coloured the characteristic uranine green. While some have thought the re-discharge of the salt water to be brought about by the action of subterranean heat, or by the difference in specific gravity of columns of fresh and salt water, Prof. Simonelli suggested that a cause might be found in the siphon action of an underground conduit of fresh water joining that of salt water at a suitably oblique angle. The explanation is not altogether convincing, though in some way or another the discharge must obviously be due to the hydrostatic pressure of underground streams originating at a higher level.

ASIA

Ancient Drainage System of Northern India.

In a paper read before the Geological Society of London and printed in its *Quarterly Journal*, vol. 75, Part 3, 1920, Dr. E. H. Pascoe traces in some detail what he considers to have been the early history of the Indus, Ganges, and Brahmaputra, as deduced from geological evidence. He brings forward the hypothesis, advanced simultaneously by Dr. H. G. E. Pilgrim in a paper since published in the *Journal of the Asiatic Society of Bengal* (N.S., vol. 15, pp. 86–99), that in mid-Tertiary times the whole of what is now Northern India was drained from east to west by a great river having its head in the Assam valley of the Brahmaputra, flowing thence along the foot of the Hima-

layas as far as the north-west Punjab, and then turning southward along a line not very different from that of the modern Indus. The idea, as Dr. Pascoe allows, is not altogether new, for a very similar suggestion was made by Mr. R. D. Oldham in the 1893 edition of the 'Manual of the Geology of of India'; but the probable course of events from the time of the formation of the Himalayan range and of the great belt of subsidence to the south and south-west is now much more fully elaborated. By tracing the distribution of the Nummulitic (marine) beds along the foot of the north-western Himalayas and the mountains of Afghanistan, Dr. Pascoe shows that this zone was occupied in Eocene times by a great gulf, which was subsequently filled by sediments. The distribution of the late Siwalik (fluviatile) beds enables him to trace the course of the supposed great river, the existence of which is indicated also by the V-shaped bends displayed by many of the Ganges tributaries while passing over the Siwalik beds before joining the main stream suggesting the conclusion that they had originally been tributaries of a river flowing in the opposite direction to that of the modern Ganges. (This is a point specially emphasized by Dr. Pilgrim.) The similarity of the river fauna of the Indus and Ganges is also used as an argument for a former connection. The changes by which the modern systems were evolved are discussed in detail by Dr. Pascoe, who postulates an elaborate series of river-captures as the chief agents in the process. Here he is perhaps on less sure ground, and, as pointed out by various speakers after the paper (including Mr. Oldham, who read it in the author's absence), the separation of the modern rivers is more probably to be sought in tectonic movements.

Rainfall of Jerusalem.

Regular meteorological observations in Palestine are scarce, and knowledge of the distribution of rainfall over the country, which would be of great economic value, is very much less than it doubtless would have been if the land had been delivered from the paralyzing rule of Turkey a century ago. In the *Bolletino* of the Royal Italian Geographical Society for July–October 1920 Prof. Eredia brings together the rainfall records for the city of Jerusalem and produces statistics covering the fifty-year period 1861–1910. The mean annual quantity is 26·1 inches, which falls on 57 days in the year, the amount being not greatly different from that of London, where the number of days of occurrence is about three times as large. The seasonal distribution of the fall is highly typical of the Mediterranean, the five hot months May to September being nearly rainless, and the five cold months November to March constituting the well-marked wet season. The middle of the hot season June, July, and August is absolutely rainless, whilst the wettest months are December and January, the latter having 6·6 inches on 12·3 days. The deviations of the individual years from the normal are rather large, and in December, which shows the greatest range, the rainfall has varied between 16·4 inches and 0·4 inch.

Trade and Communications in Siam.

Through the courtesy of the Comptroller-General, Department of Overseas Trade, we have been favoured with extracts from a recent report, received through H.M. Minister at Bangkok, by the British Consul at Chieng-mai in the interior of Siam. It announces that the line of the Northern State Railway under construction to Chieng-mai has now reached that place, though it will probably not be opened to traffic till about October 1921. This will mark an important advance in the means of communication with this part of the interior, which is

also benefiting, under the direction of a brother of the King, by the provision of a few roads suitable for wheeled traffic, hitherto entirely lacking. Of these, one from Lampang to Chieng-mai is now available for carts throughout almost its whole length of 125 miles, and for motor traffic for 75 miles. The trade of the district is still carried on entirely by transport animals with Burma, and with the Southern Shan States and Yunnan, and with French Indo-China partly by the same means, partly by boat: with southern Siam it is effected by rail and boat. Rail transport will in time tend to supersede all others. Already the railway stations at Denchai (Phre) and Lampang are busy centres for trade with the Southern Shan States and Yunnan, and when the train runs to Chieng-mai that town will also form a convenient distributing centre for the Shan States across the western borders. A very large proportion of the goods imported are of British or British Indian origin, and Japan is losing the foothold gained during the war.

Mr. Meade's Camp on the Kamet Saddle.

By an unfortunate printer's error in the footnote on p. 503 of the December number the altitude of Mr. Meade's camp was wrongly given as 23,000 in place of 23,500 feet, thereby depriving the statement of all its point. It is this very 500 feet thus omitted from the value, which gives to Mr. Meade the distinction of having made the highest camp on record.

AFRICA

The Okavango Region, S.W. Africa.

An elaborate study of the region of the Okavango on the northern borders of the old German colony of S.W. Africa has been contributed by Dr. S. Passarge to the *Mitteilungen* of the Hamburg Geographical Society, vol. **32**, 1919. The study is based both on the writer's personal knowledge and on the surveys before the war of Franz Seiner. Dr. Passarge is known as a foremost exponent in Germany of the scientific study of "landscapes" (in the sense of natural combinations of land forms), and in the present paper he employs the methods of minute analysis which he considers necessary for such study. The region, as he says, has an individuality of its own which makes it well adapted to such treatment, and the method, which depends on the precise definition of types of land-forms, and their description by a special and somewhat repellent terminology, may in this case have something in its favour, though it may be open to doubt whether the infinite gradations of nature can properly be reduced to so rigid a system. The general surface in which the Okavango has cut its valley is a tropical *Trockenwald Sandtafel* or "dry-forest sand-plateau," and the valley features consist of the *Buschwald Längstufen* ("Bush-covered longitudinal steps"), the *Ueberschwemmungs Talsole* ("Valley floor liable to inundation,") and the *Flusslaüfe* ("river-channels"). The portion of the valley under consideration is divided into four sections, differing in the mutual relations of the respective elements according to the geological character of the underlying rocks. Thus in one part the valley widens considerably and its floor is filled with swamps and islands separated by a network of channels, while in another it traverses a defile cut through a sill of the country rock. Where raised above the level of regular inundations the islands as well as the river-banks are clothed in bush-forest (favoured by the constant presence of ground water), while the flooded portions support grass only. In tracing the relations between the physical features and the human and animal life Dr. Passarge insists that man and animals are dependent, not so much upon weather, vegetation, water-supply, surface forms, geology, or soils *per se*,

but upon the combination of varying forms into certain types of landscape. Thus in this region it is the conjunction of the special landscape elements described as the "swampy black-earth steppe-depressions" with the "moderately rainy red-earth undulations covered with steppe-forest and associated with castle-like granite masses" which may permit the simultaneous pursuit of agriculture, cattle-rearing, hunting, commercial activity, and so of progressive social relations. Such elements of landscape he designates by the somewhat clumsy term "Ergänzungsformen," or such as are mutually complementary. In the region under consideration the varying conditions according to the season of the year are also of much importance: these he considers under the term "Wechselformen." An accurate knowledge of the Okavango régime is of much importance for the discussion of Prof. Schwarz's ambitious scheme for the formation of a great lake in the Kalahari, and Dr. Passarge's study may be of considerable help in this connection. That the existing river-bed is totally unable to accommodate the flood-water that comes down it, much of which is therefore lost in the swamps of its valley, suggests grave doubts as to the feasibility of using this same channel as the means of carrying south the still larger water supplies which Prof. Schwarz hopes to obtain from the Kunene.

AMERICA

The Canning River Region, Northern Alaska.

We have from time to time referred to the explorations in Northern Alaska of Mr. Ernest Leffingwell, after separating from Captain E. Mikkelsen at the close of their joint expedition to the Beaufort Sea in 1906. Those explorations were carried out entirely at Mr. Leffingwell's own expense, in a region selected by him for intensive study, previously almost entirely unknown and unmapped, namely the coast region of Northern Alaska between the Colville River and the International boundary. From 1906 to 1914, with the exception of a return to civilization to refit in 1908–9, he continued his self-imposed task in that inhospitable region aided by one other white man only, and without many of the resources enjoyed by Government surveyors. His full report, embodying all the results of his surveys and observations, was issued last year as Professional Paper 109 of the U.S. Geological Survey. It is a valuable document, as giving (to quote from a preface by Mr. A. H. Brooks) "not only his deductions and generalizations, but also a detailed record of the observed facts." The field covered is so wide that only a general summary can be here attempted. The introduction includes accounts of the itinerary, equipment (general and scientific), the methods of survey and of map-construction, and brief notes on the work done in Hydrography, Meteorology, Tidal and Magnetic observations, Ethnology, and Zoology. Particular care was devoted to the survey, which has for the first time supplied a detailed chart of that little-known coast based on triangulation, supported by astronomical observations for latitude and longitude, whilst bearings to half a dozen mountain peaks supplied a basis for the inland topography. The charts of the coast region are on the scale of 1/125,000, whilst a reconnaissance map on half that scale embodies the topographical work during trips inland to the east of the Canning river. The full descriptions of the instruments and methods employed permit an estimate to be formed of the probable degree of accuracy.

The first main section gives a general sketch of the geography, whilst the geological and morphological observations are dealt with separately later. This separation is perhaps to be regretted, as it involves some amount of repetition and an absence of all mention of geological structure in the topographical

description. The Canning river region may be broadly divided into the mountains to the south and the Arctic slope to the north. The mountains are a section of the system which traverses northern Alaska from west to east; formerly regarded as a part of the Rocky Mountains, it is now placed by itself as the Arctic Mountain system. In the portion explored by Mr. Leffingwell the width is probably 150 miles and the general elevation about 6000 feet, though there is a small group of snow-covered mountains—the Romanzoff Mountains of Franklin, reaching 9000 feet. For the main range, both east and west of the Canning, the writer uses the name Franklin Mountains, adopted by Dease and Simpson for the section west of that river. Their northern limit is sharply marked by a bold escarpment rising 2000 to 3000 feet above the rolling upland, and two notable peaks, Chamberlin and Salisbury, rise above the general level. The Romanzoff Mountains, the eastern continuation of the Franklin range, are much more jagged than the other mountains of the region, and many separate peaks and ridges stand out from the general skyline. Three subordinate ranges lie outside the Franklin range, and the northernmost falls in a bold scarp to the rolling tundra upland, which is in sharp contrast to the mountains, sloping gradually seaward as a nearly featureless plain, and merging more gradually with the equally featureless coastal plain. The whole region is drained by closely spaced northward-flowing rivers. We can here say nothing of the detailed discussion of the geology and morphology, but reference must be made to the important final section on ground-ice, of the formation of which Mr. Leffingwell has already put forward a theory differing from those of most other observers, though quite independently coming very near that of Dr. Bunge, Baron Toll's companion in his explorations in Northern Siberia. Mr. Leffingwell's previous paper on the subject was noticed in the *Journal*, vol. 48, p. 172; the present discussion is far more detailed, and is of special value for the care taken to bring together the views of all previous writers on the subject.

POLAR REGIONS

The Danish Expedition to North Greenland.

In reference to our note on this expedition in the *Journal* for October 1920 (p. 323), Mr. M. P. Porsild writes to point out that we were in error in ascribing to the leader of the new expedition the glaciological work of the Mylius-Erichsen expedition of 1906–08, and the leadership of the Trans-Greenland expedition of 1912–13. These services were performed by Mr. J. P. Koch, now Colonel in the Royal Danish Army, while Mr. Lauge Koch, member of Rasmussen's expedition of 1916–18, is his nephew—a much younger man—who made his first research trip to Greenland in 1913, and is a geologist and cartographer. At the date of writing from Copenhagen (October 12) Mr. Porsild had just heard from Mr. Lauge Koch that the latter had found quite exceptionally favourable ice-conditions in Melville Bay, and had proceeded without delay to his winter quarters in Inglefield Gulf.

GENERAL

A possible General Fall of Sea-level in Recent Times.

Whilst evidences of changes in the relative level of land and sea abound everywhere, it is no easy matter to decide in individual cases whether the change has been due to a movement of land or of sea. The question has been discussed by various writers in relation to changes in the region of the Mediterranean Sea, the idea of a general change of level of this having found a

good deal of support. A change of level affecting all the seas of the world alike may seem at first more difficult of acceptance, but has also met with support, on the ground that the amount of water contained in the oceans would vary considerably with the amount locked up in solid form in the polar ice-caps. Prof. R. A. Daly brings together some facts tending, in his view, to favour the idea of a recent world-wide sinking of ocean-level, in the *Geological Magazine* for June 1920. He cites observations of old strand-lines from eastern North America, the West Indies and South America, Samoa and other parts of Australasia, as well as from Graham Land on the borders of the Antarctic Region, all pointing, he thinks, to a general fall of sea-level of about 20 feet within recent times. Some of the cases, notably those of the Micmac terrace in the Gulf of St. Lawrence and the lowest coastal-plain terrace southward of New York, where we find practical uniformity of the terrace level for distances of 300 and nearly 1000 miles respectively, are with difficulty to be explained on the supposition of an uplift of the land. In order that the theory may be justified, it is of course necessary to suppose the terraces not only accordant in level, but of contemporaneous age, and Prof. Daly allows that the evidence for this is at present meagre, though the emphasis laid by all observers on the *recent* character of the strands tends in favour of synchronism. It will be remembered that in discussing the recent geological history of the Malay Archipelago, Prof. Molengraaff, in the paper read before the Society in May 1920, gave reason to suppose a widespread *rise* of sea-level to the extent of at least 40 fathoms, consequent on the melting of the ice-caps at the close of the Ice age. Prof. Daly would no doubt reply that this major and more noticeable movement may have been followed by one of less extent in the opposite direction. Other facts which might seem at first to tell against the theory could no doubt be accounted for by movements of the land, which have certainly taken place, and which would locally destroy the evidence for a general fall of sea-level. Thus in his recent paper (noticed in the December number, 1920, p. 501) on the submarine contours round the Orkneys Dr. Flett lays stress on the total absence from the group of the old shore-lines which are so conspicuous round the mainland of Scotland. But in any case this proves a differential movement, and on the theory of a general fall of sea-level a sinking of the islands might be supposed to keep pace with, or even outrun, the postulated fall of sea-level.

Honour to Dr. Hamilton Rice.

We are pleased to learn that the Elisha Kent Kane of the Geographical Society of Philadelphia has been awarded to the South American explorer, Dr. A. Hamilton Rice (also Gold Medallist of the Royal Geographical Society). It was to be formally presented at the meeting of 1 December 1920.

OBITUARY

Edward Priaulx Tennant, 1st Baron Glenconner.

By the death of Lord Glenconner, at the relatively early age of 61, the Society has lost an excellent friend, valued Member of Council, and generous benefactor. Inheriting large interests in many parts of the world, he had travelled widely, and his keen interest in geography made him a regular

attendant at the meetings of the Society when he was in London. He was elected to the Council as Sir Edward Tennant in 1909, and with brief intervals served on it until his death. In 1912 he contributed generously to the fund raised for the purchase of the Society's present House, and on several occasions since gave substantial help in the purchase of pictures and rare maps (such as the celebrated Hondius map) which were beyond the means of the general fund of the Society. The treasures and amenities of Lowther Lodge owe much to his generosity in this way, and the Society will long preserve a grateful memory of his goodness of heart and his distinguished friendship.

Archdeacon Hudson Stuck, D.D.

All who have followed the geographical work in Alaska of Archdeacon Hudson Stuck, as recorded in the *Journal* from time to time during the past seven years, will learn with much regret that the traveller, still in the full vigour of late middle age, died after a short illness at Fort Yukon, Alaska, on 10 October 1920. The news was received in New York two days later by telegram, at the Department of Missions of the Protestant Episcopal Church of America, of which the deceased had been a missionary. Beyond a brief announcement in the *New York Herald* of October 12, no information has yet reached us on the subject, and we are ignorant of the nature and circumstances of his fatal illness ; we can only, therefore, briefly summarize the Archdeacon's career and geographical achievements, which latter won him the award of the Back Grant of this Society's Council in 1919. Hudson Stuck was born in England in 1863, and emigrated to the United States at the age of 22, subsequently taking Holy Orders after graduating in theology at the University of the South in 1892. For some years his work lay in the United States, and before 1904, when called to the Missionary Archdeaconry of the Yukon, he had been Dean of St. Matthew's Cathedral, Dallas, Texas. As a keen climber he soon turned his thoughts to a possible ascent of Mt. McKinley, the highest summit of North America, but his ambition was only achieved nine years later, after the mountain had already been much in the public mind through the claim of Dr. Frederick Cook and the partial ascent by Prof. Parker and Mr. Belmore Browne in 1912. Archdeacon Stuck's success in achieving the first complete ascent in 1913 was largely due to foresight used in sending up supplies well in advance, the difficulties consisting not so much in those of the actual ascent from a mountaineer's point of view as in its remoteness from any suitable base of operations. The ascent was graphically described in *Scribner's Magazine* for November 1913 (see *Journal*, vol. 43, p. 83), and subsequently more at length in his book, published by Scribner at New York in 1914, 'The Ascent of Denali'—this being in the Archdeacon's opinion the true native name for the mountain, the retention of which in general use he strongly advocated. During his touring work in connection with the Yukon Mission he travelled many thousand miles through Alaska, of which he thus gained an exceptionally wide knowledge. It was put before the public in a series of interesting, informing, and well-illustrated works entitled respectively, 'Ten Thousand Miles in a Dog Sled' (1914), 'Voyages on the Yukon and its Tributaries' (1917), and 'A Winter Circuit of our Arctic Coast' (1920), all published by Scribner in America (the last also by T. W. Laurie in this country). All have been noticed in the *Journal*. The last-named described the unique experience of a journey round the whole Arctic coast of America, made for the purpose of gaining acquaintance with the Eskimo scattered over that great extent of country, of which a preliminary account had appeared in the *Journal* for October, 1918

(p. 267). It was during this journey that the Archdeacon was able to give some assistance to the Arctic explorer, Stefansson, then being brought seriously ill from the Arctic coast to Fort Yukon.

Reginald Farrer.

By the death of Mr. Reginald Farrer on October 14, at the early age of 40, this Society loses one who, already distinguished as a writer and traveller, was on the eve of being elected a fellow. Only this spring he had been awarded the Gilt Memorial for his travels in Kansu. Farrer was first and foremost a lover of nature, though he was not a naturalist in the accepted sense. Unversed in natural science, he was nevertheless a keen observer, and indefatigable in taking notes of what he saw ; he brought to his work—the collecting, raising, and cultivation of alpine plants—a highly trained intellect. But it is as a writer he is best known, and his contributions to geography, in its wider meaning, took the form of artistic presentation ; by his insurgent style he not only conveyed vivid impressions of scenery, but made the plants which he described rise up and live before his readers. After going down from Oxford, Farrer travelled in Korea, China, and Japan. A few years later he visited Ceylon. It was during this period that some of his best novels were written, and the mystic vein which runs through them may be attributed to the fascination the Buddhist religion had for him.

It was not, however, till 1914 that Farrer made his first big journey in search of plants. For many years he had spent his summers travelling in remote parts of the Alps, Dolomites, and other ranges nearer home collecting rare alpines. But in 1914, in company with Mr. W. Purdom, he went to the Tibetan border of Kansu, where he spent two years. The results of this expedition were set forth in a book entitled 'On the Eaves of the World' and in two delightful lectures delivered before this Society.

In 1919 Farrer went to the north-east frontier of Burma, and again met with considerable success. He had a wonderful eye for a good plant, and an almost uncanny knowledge of how to preserve seed. His specimens were always beautifully preserved and described, his seeds always germinated. As an all-round plant collector he probably had no equal. His knowledge of alpine regions and conditions, as well as his practical experience as a gardener—for he raised his own plants in his Yorkshire garden—made him a recognized authority on rock plants, and his last published work, 'The English Rock Garden,' is likely to be a standard for many years. Other books on gardening include 'My Rock Garden,' 'Alpines and Bog Plants,' 'In a Yorkshire Garden.'

After a season spent in the Htawgaw Hills, Farrer in the spring of this year moved on to the Ahkyang, one of the northern tributaries of the 'Nmai hka ; and there on the remote Chinese frontier be died of diphtheria.

Farrer was a man of exceptional qualities. He wrote a great deal, and though he was guilty of hyperbole and extravagant language, though he paid scant heed to the formulæ of Chinese nomenclature, or to the exact requirements of latitude and longitude, yet he succeeded in drawing attention to an aspect of geography too often neglected—the sheer beauty of scenery and the refining influence of vegetation on it. He was too a gifted talker, deeply read and widely travelled. The writer looks back on the days spent in his company in Burma as one of the most delightful of episodes.

Farrer died as he would have wished, in harness and in the hour of his success. When he faced single-handed the solitude of the grim Lisu land he

went to cross a mightier divide than the Salween–Irrawaddy, to reap a richer harvest than he wrote of in his charming letters. Over his lonely grave in the drizzling jungles of the North-East Frontier, the Nomocharis and Primulas which he loved will bloom year by year, his for all time; while to us he has bequeathed an example of resolute courage and two plants of outstanding merit, rightly called after the bold discoverer, *Gentiana Farreri* and *Lilium Farreri*, ours for all time. F. K. W.

CORRESPONDENCE

The Sultanate of Witu.

MAY I be allowed a short comment with reference to the interesting paper appearing in the *Journal* for November on the evolution of the Protectorate and Colony of Kenya in so far as it relates to the curious history of the Witu Sultanate?

This Sultanate has, as stated, occupied a peculiar position. Although included geographically in the East Africa Protectorate by Orders in Council, it did not form part of the Sultanate of Zanzibar and was not subject to the agreement of 1895 between Great Britain and Zanzibar, whereby the British Government took over the administration of the Mainland Dominions of the Sultan of Zanzibar.

It is not quite correct to say that after the disturbances of 1893 in the Witu Sultanate "the flag of the British Protectorate replaced that of the B.S.A. Co., not that of Zanzibar." The disturbances were put down by a Naval Brigade aided by Zanzibar troops under the direction of the late General Sir Lloyd Matthews, Chief Minister of the Sultan of Zanzibar, and when the present Sultan was afterwards installed he was given a flag, devised, I believe, by the General, which was flying at the Sultan's residence in 1919. The flag, designed presumably with the view of embodying the origin of the new Sultan's powers, was the red flag of Zanzibar with a small "Union Jack" imposed in the centre. The Sultan was also accorded a salute of seven guns.

A few years ago the Sultan [of Witu], who has always been a loyal friend of the British, entered into an agreement with the Protectorate Government resigning his rights over unoccupied lands within the Sultanate and receiving in exchange a small addition to his revenue.

British officers in the Sultanate have always acted nominally "by leave of and in assistance to the Sultan." In a recent case before the High Court it was decided that that Court, to which appeals lay from all subordinate courts in the Protectorate, had no jurisdiction to hear an appeal from the Court of the Kathi of Witu, which was a Sultan's Court and not a Protectorate Court (E.A.L.R. vi. 40).

Those instances show that the independence of the Sultanate was observed till the Order in Council of June 1920, under which it would appear that its chequered career has at last come to an end in its annexation to the colony of Kenya.

It is to be hoped that its quaint flag, as a relic of the times when the eyes of Europe were once anxiously turned on Witu, will be carefully preserved in the new colony.

Yours faithfully,
R. W. HAMILTON.

Wiveliscombe, Somerset,
14 Nov. 1920.

We are indebted to Mr. Hamilton for his interesting note on the rather obscure history of the Sultanate of Witu and the British Protectorate. But we think he has misunderstood the sentence in our article to which he takes exception: "the flag of the British Protectorate replaced that of the British East Africa Company, not that of Zanzibar." It is clear from the despatch of Mr. Rodd (No. 1 of Africa, No. 1, 1894: C.—7248) that on 31 July 1893 the flag of the B.E.A. Co. was hauled down, and the flag of the Protectorate hoisted. This flag is described in No. 31 of Africa No. 9 (1893), as "the red Arab flag with a small Union Jack in the centre." Our point was that the flag hauled down was that of the B.E.A. Co., not that of the Sultan of Zanzibar: whence it appeared that Witu was not at that date included in the mainland possessions of the Sultan of Zanzibar, where his flag was flown, though they were administered by the Company.—ED. *G.J.*

MEETINGS: ROYAL GEOGRAPHICAL SOCIETY: SESSION 1920–1921

Second Evening Meeting, 22 November 1920.—The President in the Chair.

ELECTIONS.—Mrs. Margaret Adair; Lieut. C. J. Adams, R.N.V.R.; Alex. William Adeney; John Ballot; T. Harrison Caffyn Bannister; William Arthur Barlow-Wheeler; T. Alexander Barns, F.Z.S.; Eli Henry James Barrett, C.E.; W. Fortescue Barrett; Miss Elizabeth de Beaumont; Captain Walter S. Hall Beddall; Cecil James Bell; Prof. W. Noel Benson, D.SC., B.A.; Joseph E. J. Bessant; Major-General Sir William Beynon, K.C.B.; Arthur E. Birch; Major W. T. Blake; Ralph W. T. Bodilly; Miss Mary A. Bogart; Lieut.-Colonel S. H. Bridcut, O.B.E.; E. Richard Burgess, M.A.; William L. Burnham; Commr. Bernard Buxton, D.S.O., R.N.; Captain Alexander George Campbell, D.S.O.; Frank George Carpenter; Harold Cartwright; Captain W. S. Caulfield, M.C.; William Lewis Cazalet; Charles Eric Chadwick; Frank Kynock Clark, M.A.; Ernest Clutterbuck; William H. Connell; Major S. L. Courtauld, M.C.; Major W. Gilliat Cragg, D.S.O.; A. Pearl Cross; Arthur Darbey; Reginald Davies; Major Alfred Heddon Davy; Miss Mary Cecilia Delany, M.A.; Frank Dixey, M.SC., F.G.S.; Lieut. Cyril C. Duchesne, M.C., R.E.; Reginald H. Edwards; Henry H. H. R. Elie-Lefébure; Captain Leon MacIntosh Ellis, B.SC.; A. Howard Evans; Evan Edward Evans; Captain Vere H. Fergusson; Colonel William James Smyth Fergusson, C.M.C.; Miss Ida Mary Fitze; Captain Octavio de Gusmaõ Fontoura; Mrs. Joan Rosita Forbes; Lieut. Robert B. W. Forsyth; Percy Tillson Gask; J. Archibald Gillett; Frank Gecil Glass; Roland Gorbold; Edward Walter Gray; Arthur Head; William Helme; Lieut.-Colonel Malcom Henderson, D.S.O.; Norman McLeod Henderson; W. Maxwell Henderson-Scott; Miss Daisy Herbert; Murad Bey Heshmat; Harry Winch Hill; Captain Phelps Hodges, R.F.A.; Johannes Holmberg; James Dearden Holmes; Rev. Frederic Hood; Handforth Hope-Jones; Squadron Leader T. O'B. Hubbard, M.C., R.A.F.; Albert Llewellyn Hunt; Captain Graham Seton Hutchison, D.S.O., M.C.; David James Hutton; Melvill Allan Jamieson; Lieut. Arthur Oswald Jenkins; Lieut.-Colonel Edward Herbert Keeling, I.A.; James Dickson Kemp; Captain F. A. L. Lawrence; Vivian Lloyd Le Gren, B.A.; Miss Lucy Lee; Major T. Lethaby, O.B.E.; Tennant McNeill; Mrs. C. C. Manifold; Henry William Mardon;

Miss Grace Meiklejohn ; Captain E. Ballantyne Methven, M.C. ; Rev. J. George Miller, M.A. ; Richard George S. Miller ; William F. Mindham ; John Henry Morton, A.M.I.MECH.E. ; The Rt. Hon. Earl of Mount-Edgcumbe ; W. Morgan Moylan, M.I.C.E. ; Captain D. H. Nicholson, M.C. ; Lieut. Cecil Rex Niven, M.C., R.F.A. ; Henry Philip Noakes ; Lieut. Graham Philip Noble, R.N. ; Miss Ethel M. Odell ; Ernest Oughton, O.B.E. ; Laurence Bernard Page ; Edward Arthur Parker ; Prof. Charles T. Paul, PH.D. ; Henry St. George Peacock ; F. Willoughby Penny ; Major E. S. Phillips, D.S.O., R.A. ; Arthur C. R. Portway ; Percival R. Rayner, B.SC. ; Major Alex. de Clanay Rennick; Captain A. B. H. N. Richardson ; Mrs. Crompton Roberts ; Mrs. Emily Roberts ; James Inglis Robertson ; Rev. A. Cameron Ross ; Major W. J. Ross, O.B.E., R.E. ; John L. Quiller Rowett ; Captain C. L. Saunders ; Robert E. Saunders ; Sir William Schooling, K.B.E. ; A. Sims ; William Slade-Hawkins ; Arthur Henry Slee ; J. Williams Sly ; Lieut. Douglas Richmond Stanley, I.A. ; Jasper Stembridge ; Herbert C. W. Stotesbury ; Major F. Sutton, D.S.O., R.A. ; Leonard J. Sutton, B.A. ; Captain Gerald Hope Sworder ; James Arthur Trevor Thomas ; Maurice M. Tomkins ; Bernard Tripp ; K. M. Jalal Uddin ; Eubule John Waddington, O.B.E. ; Captain the Rev. R. Ellison Walker, O.B.E. ; Jasper D. Ward ; Reginald H. Ward ; Thomas W. Wardhaugh, M.LITT. ; J. Glen Wardrop ; Frederick William Watson ; Charles Henry Edward West, F.S.I. ; Charles Wesley Whitehair ; Miss Jessie R. Wilkinson ; David Evan Williams, M.A. ; Captain J. H. Williams ; Lieut.-Colonel Douglas Vere Willoughby, D.S.O., I.A. ; Herbert Wilson, J.P., F.G.S.

PAPER : A Visit to Bokhara in 1919. Major F. M. Bailey.

Third Evening Meeting, 6 December 1920.—The President in the Chair.

ELECTIONS.—Evelyn Leigh Atkinson, B.A. ; Miss Nellie Atkinson ; Major John Trafford Avison ; Frederick William Bateman ; Captain A. W. D. Bentinck ; Raphael West Cilento ; Frederick Carruthers Cornell ; The Rev. F. B. Fisher, D.D., PH.D. ; George Hugh Ireland ; Miss Edith Helena McLean ; Mrs. Edith Nicholaus ; Sir Michael O'Dwyer, G.C.I.E., K.C.S.I. ; The Rev. W. H. Rainey, B.A. ; The Rev. Oliver Percy John Smith ; Bertram Frank Spicer ; Lieut.-Colonel John Edward Tennant, D.S.O., M.C. ; Major-General Sir William Thwaites, K.C.M.G., C.B.

PAPER : From Baghdad to the Caspian in 1918. Major-General L. C. Dunsterville.

Second Afternoon Meeting, 13 December 1920.—The President in the Chair.

PAPER : The History of the Chronometer. Lieut.-Commander R. T. Gould, R.N.

The Geographical Journal

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THE MOUNT EVEREST EXPEDITION

AT the meeting of the Society on 10 January 1921, the President made the following announcement:

"At the meeting of November 8 I stated that there were then political obstacles in the way of our proceeding with preparations for the expedition to Mount Everest. Those obstacles, I am glad to say, have now been removed. Colonel Howard Bury, who went to India last summer on our behalf, was able to put our proposals before the Government of India with such persuasiveness that Mr. Bell, who is now in Lhasa, was instructed to ask from the Tibetan Government permission for us to send an expedition to explore Mount Everest. And we have just heard from the Secretary of State for India, who throughout has been most sympathetic to us, that the permission has been given.

"The political obstacles are therefore removed, and the Alpine Club and our Society will now organize an expedition which will have as its object the ascent of the highest mountain in the world—a mountain to which even the approaches are as yet unknown to Europeans. Such an expedition must be essentially a great adventure. High risks will have to be run and severe hardships endured—risks from icy slopes and rocky precipices and such avalanches as buried Mummery's party on Nanga Parbat twenty-six years ago; and hardships from intense cold, terrific winds, and blinding snowstorms. In addition there will be the unknown factor of the capacity of a human being to stand great exertion at a height more than 4000 feet higher than man has as yet ascended any mountain.

"The expedition will therefore, as I said, be a great adventure. But for the consolation of those who are never happy unless they can dub an expedition 'scientific,' I may add that it will be in the highest degree scientific also. For we may take it as certain that the summit of Mount Everest will never be reached unless we have first explored with the greatest care all the approaches to it through country at present entirely unknown; and then examined, mapped, and photographed the mountain itself in fullest detail. We must know all we can about the country around Mount Everest, about Mount Everest itself, and about the climatic conditions which prevail in that region. Our geography of it must be complete.

"In the present year the Alpine Club and our Society propose to organize a reconnaissance party to acquire this geographical knowledge. Next year we will send to Tibet a climbing party to apply it in a great effort to reach the summit.

"We hope that the reconnaissance party may cross into Tibet when the passes open, about the end of May, so that all the best part of this year may be available for their preliminary work. The final plans will then be made for the full assault upon the mountain in 1922.

"We have been assured of the cordial co-operation of the Government of India and more particularly of the Surveyor-General, who by great good fortune happens to be Colonel Ryder, who was chief surveyor officer with the Tibet Mission in 1903–4 and has seen Mount Everest at a lesser distance than any other European. With this assistance and with the aid our two Societies can give we believe that this expedition will start under better auspices than have favoured any other attempt to scale a high Himalayan peak. We mean to secure the very best men to be had; give them every advantage we can; then trust them to pioneer the way to the loftiest summit of this planet. And when that has been reached man will have taken a further big step towards the mastery of his surroundings."

A joint committee of the Royal Geographical Society and the Alpine Club has been formed to organize the expedition. Lieut.-Col. Sir Francis Younghusband (President), Mr. E. L. Somers Cocks (Treasurer), and Colonel E. M. Jack represent the R.G.S.; and Prof. J. Norman Collie (President), Captain J. P. Farrar (Past President), and Mr. C. F. Meade, the Alpine Club. The President R.G.S. will be President of the Committee for the work of the first year, and the President A.C. for the work of the second year. The Secretaries R.G.S. and A.C. will act as Secretaries to the Joint Committee.

At the meeting of the Society on January 24 the President announced that the Joint Committee had appointed Colonel C. Howard Bury to be Chief of the Expedition, and Mr. Harold Raeburn to lead the mountain reconnaissance this year.

The paper read to the Society by Brig.-General the Hon. C. G. Bruce, and published in the January number of the *Geographical Journal*, with the discussion following the paper, gives a full account of our present knowledge and lack of knowledge of the mountain, and indicates the lines upon which the reconnaissance will be made and ascent will be attempted. In the present number we publish some observations by Lieut.-Col. Howard Bury on the approaches to the mountain; and all further news of the organization and progress of the expedition which it is possible to give will be published from time to time in the *Geographical Journal* and the *Alpine Journal*. Brief announcements will also be made by the President

R.G.S. at meetings of the Society, and by the President A.C. at meetings of the Club. These will be communicated to the Press in advance, so that all newspapers may have an equal opportunity of publishing authentic information on the morning following any such announcement. No exclusive arrangements will be made with any newspaper or magazine, and no information will be given in any other way either by the Joint Committee or by individual members of the committee or of the expedition. The Committee will, in short, use their utmost endeavour to secure that the chronicle of the expedition shall be well considered and accurate; and no credence should be given to any statements other than those published by their authority.

A first estimate of the cost of the expedition shows that it will be necessary to raise a sum of not less than £10,000 to provide for the work of two years, and the President appeals to Fellows for subscriptions.

A VISIT TO BOKHARA IN 1919

Major F. M. Bailey

Read at the Meeting of the Society, 22 *November* 1920.

IN August 1918 a mission was sent by the Government of India to the Soviet Government of Turkistan, who were then suspected of coming under German influence. An account of this mission has been given elsewhere. We are now concerned with a visit to Bokhara which was the sequel to this mission.

The position of Bokhara was similar to that of an Indian Native State. The Russians had complete control of the railway lines. The main Transcaspian line passes through Bokhara territory from Charjui to Ziadin, and at each station was a small Russian colony. There was also a railway line from Kagan to Termez on the Oxus *viâ* Karshi, while there were some Russian garrisons at Termez and at other places along the Northern Afghan frontier. There were also a number of Russian business people in Bokhara city. The population of Bokhara consists of Mohammedans, with a few Jews in the cities. The population is entirely monarchist. When the Bolsheviks first came into power they imagined that they could revolutionize the whole of Turkistan. There was a small band of ruffianly Bokharan subjects, most of whom had been forced to leave the country, who styled themselves the "Young Bokhara Party." These people got into touch with the Bolsheviks and led them to believe that they had a large following in Bokhara. Flushed with their first success, the Bolsheviks imagined that their ideal of World Revolution was at hand and decided to lend a helping hand to their neighbours.

In February 1918 Kolisoff, a former oiler on the railway, and at that time Chief Kommissar, who has I believe since been shot for embezzling

money, took a force down the railway from Tashkent to Kagan, the railway station for Bokhara distant about 10 miles from the city. From here he sent an ultimatum to the Amir requiring him to accede to the demands of the young Bokhara party within twenty-four hours. The Amir, whose foreign relations had always been in the hands of the Russians, had no idea how to deal with such a situation, but sent some equivocal reply; Kolisoff remained with his force at Kagan, but sent some delegates to discuss the matter with the Amir. The next day a disturbance broke out near Kagan between the Red troops and some Bokharan subjects in which lives were lost. The news of this rapidly reached

Sketch-map of Russian Turkistan

Bokhara city, where the people rose and massacred all Russians in the city, including of course Kolisoft's delegates. The trouble then spread throughout the State, and all Russians along the railway lines and some of the small garrisons on the Afghan border were killed. The railway lines were taken up, and the lines to Karshi and Termez have never been repaired. The Bokhara army is of the most inferior quality, and it has always been a puzzle why Kolisoff did not at once move on Bokhara instead of retiring to Kizil Tepe station some 17 miles off. Here a treaty was signed by Kolisoff and the Amir's reprentatives on 25 March 1918, by which the Bolsheviks recognized the complete independence of Bokhara.

BOKHARA CITY, WITH THE TOWER FROM WHICH CRIMINALS WERE THROWN

THE "ARK" OR CITADEL, BOKHARA

CITY WALL OF BOKHARA

WATER TANK IN BOKHARA CITY

This success on the part of Bokhara made them over-confident that the Bolsheviks were afraid to attack them; and their whole dealings with the Soviet Government of Turkistan reflected this success, whereas the real reason that the Bolsheviks did not attack Bokhara was the fear of arousing a *jehad* among the Mohammedan population of Central Asia.

From this time the Russians maintained a residental at Kagan in the same way as before the revolution, the chief difference being in the personality of the resident. Instead of the old-fashioned Russian official who never was out of uniform, the agent (a man named Pechatnikoff) had in pre-revolutionary days made a living by hawking lamps in Bokhara city. The Bokharan Government kept a representative in Tashkent, but the Bolsheviks were very desirous that he should have nothing to do with foreigners.

The situation between the Bolsheviks and Bokhara was naturally always very uncertain. The Bokharan monarchy feared that another attempt would be made to install a revolutionary government; while the Bolsheviks, who were fighting against their enemies in Transcaspia, always had a feeling of insecurity with the possibly hostile State in their rear and on their lines of communication. What exasperated them most was the certainty that a very small force acting with determination could polish off Bokhara, and the only thing that deterred them was the fear of rousing hostility among all the Mussulman inhabitants of Central Asia, including Afghanistan, who all look with some veneration on the fanatically Moslem state of Bokhara.

The whole of the north of Bokhara is desert and steppe, with the exception of the oasis watered by the Zarafshan river, which flows through Samarkand and finally loses itself in the sands west of Bokhara city. The position of Bokhara is very much dependent on the neighbours upstream, who by damming up the river and flooding the area between Samarkand and Bokhara, could rapidly starve the city and oasis and force the government to accept any terms demanded.

The hilly south-eastern part of Bokhara is thickly populated and could make a long stand, but it is probable that with the loss of the city the prestige of the government would suffer such a blow that the State would break up. We shall soon see whether this is so, as the latest news is to the effect that the city has been captured by the Reds.

After having lived a year in Tashkent, in the autumn of 1919 I decided to leave, and succeeded in getting employment in a branch of the Bolshevik Secret Service. The Bolsheviks were very anxious to get accurate information about affairs in Bokhara, and had great difficulty in doing this, as their spies were frequently caught and drastically dealt with. One man brought them information that a whole regiment of Indian troops was hidden in a village surrounded by a cordon of Bokharan soldiers, whose duty it was to prevent the news of their presence leaking out. My duty was to obtain news of this and other matters.

We left in a goods-wagon one morning and reached Samarkand in something under forty-eight hours. Near Samarkand the train passes through a gorge where Tamerlane in the 14th century caused an inscription to be carved. The Russians on their conquest of the country also carved an inscription surmounted by an Imperial Eagle. The Bolsheviks have destroyed the Russian memorial as being too reminiscent of their Imperial days, but have left Tamerlane's inscription. In Samarkand we were told that our train would go on at 9 a.m.; but knowing a little about Soviet Russia I calculated that we should be quite safe to leave the train till 10; this gave us time to pay a hurried visit to the ruins of Tamerlane's capital, and we rushed round with a camera and took a few photos, but the early hour with the low sun and the necessity for secrecy forced us to take views frequently from unfavourable points of view. One of the large minarets in the Registan is in danger of falling and is held up by wire. I found that we had hurried quite unnecessarily, and our train did not go on till the evening.

Our travelling companions on this part of our journey were a party of Afghans, three small traders and three soldiers who were taking messages to the Governor of Mazar-i-Sherif and to the Afghan Consul in Bokhara. These men called themselves an Afghan Mission, and bluffed the railway authorities into giving them special accommodation on the train. They told us that the Afghan troops had occupied Peshawar, Attock, Lahore, Delhi, and were approaching Bombay.

We reached Kagan, the station for Bokhara, in the early morning. Bokhara city is about 10 miles north of the main railway line and connected to it by a light railway, which however was not running. I was here in the character of a Bolshevik secret agent working against Bokhara, and it was necessary for me to obtain permission from the Bokhara authorities to enter the town—a very difficult matter had I been a genuine Bolshevik. I had provided myself with a private letter saying I was a poor Austrian prisoner who wished to go to Bokhara city to make some purchases, and the true Bolsheviks considered me very clever to be able to get this permit in their interests.

We went to an hotel at Kagan, but it was full. While there a typical incident of life under the Bolsheviks occurred. A party of Red Guards from the secret police arrived, and removed a man from one of the rooms; we found out that he was himself a spy but had told some friends so, and this had got round to his employers, who would doubtless deal severely with him.

Stopping in the hotel was Mahendra Partab, a noted Indian revolutionary who had been living in Berlin most of the war. I had a long and interesting talk with him in German. He believed I was an officer prisoner of the Austrian army who had been captured early in the war. He made a curious statement regarding our rule in India. I asked him how it was that when we had the English nearly beaten in the war we

received no help from the 300 million oppressed people of India, on whom we had counted for considerable support; not only this, but we gathered that these Indian troops were fighting valiantly for the English on all fronts. He replied that that was a matter which he had often been asked to explain. The fact was that a victory of the central powers would have resulted in a Mohammedan Empire of some sort being established to replace the British, as Germans and Austrians were not people who had much success in such matters, and this would have been more oppressive for 220 million of the population than the present rule. I then asked him if no Mohammedan troops had fought for the English. He said that there were a few from the ignorant and uncultured frontier tribes.

A curious thing happened in Kagan. We received a telegram in cipher from Tashkent asking us to make careful inquiries about "Colonel Bailey of the Anglo-Indian Service." To this we sent a reply calculated to put the Bolshevik authorities off the scent.

After one night in Kagan I left for Bokhara, driving the distance along an execrable road. I had great difficulty in entering the city gates, and was kept some hours waiting in a tea-house at the gate.

I lived in Bokhara for about two months. Many Russians and some Austrians who had fled from the Bolsheviks were also living there. There were also some of the chief Mullahs from Tashkent and other places who had been obliged to fly from the atheistical Soviet Government.

The bazaars are most interesting. There is a special Jewish quarter and a Hindu Serai, where about twenty-five Hindus were living. They are all small traders and moneylenders, and are found in most large cities in Western Chinese Turkistan, and at Osh, Andijhan, and several cities of Russian Turkistan besides Samarkand and Bokhara, but they do not go as far north as Tashkent. They all come from Shikarpur in Scind; they have suffered great loss under the Bolsheviks, as they are typical "speculators." Once when I was waiting in a chemist's shop two Mohammedans came in who talked in Punjabi; but I could not, of course, speak to them or find out who they were. The Hindus and Jews are not allowed to ride a horse or in a carriage in the town, and are obliged to wear a string round their waist outside their cloaks, and may not carry arms. I talked in Russian with some of the Hindus, but could not say who I was or let them know that I could speak their language.

Russians, when in Bokhara, wear the brilliantly coloured *khalat* or robe over their own clothes, and on their heads the small *sart* skull-cap, or in winter a fur cap of the Russian pattern. The Mohammedans wear large white turbans. Nearly every one in Bokhara speaks Persian, and even when talking Turki, I noticed that the traders often used Persian numbers.

Since the disturbances in Russia the traders have been obliged to go to India for their wares, and large caravans arrived frequently from Peshawar through Afghanistan. One enterprising man brought a quantity

of ladies' boots, clothes, and hats, which by now doubtless adorn Komissars' wives. One occasionally saw some old Bokharan brass money, but the chief currency was Russian and Bokharan notes. Only the old Imperial paper money and that issued by the Kerensky government was accepted in the city, but the Turkistan Bolshevik money could be exchanged at about 10 roubles to 1. When purchased in paper roubles everything was very expensive. For instance, a pound of Indian tea cost 180 roubles, or about £18 at the pre-war rate of exchange; cheap cigarettes ("Scissors" was a favourite brand) cost 10 to 12 roubles for a packet of ten. I was obliged to pay 9 roubles each for 5-grain quinine tabloids. I was offered 200 roubles for a 10-rouble note, and 1600 for a 100-franc gold piece, and no doubt, had I really wished to sell and had bargained, I could have obtained more.

At one time during my stay there was very serious trouble between the Turkistan Soviet government and Bokhara. The Turkistan government used to purchase a good many things from Bokhara, mostly goods of European manufacture imported through Afghanistan. As Bokhara refused to accept their local currency, payments were made either by exchange of cotton oil or by payment in Kerensky or Imperial money. Kerensky's government had issued some 250 and 1000 rouble notes properly numbered and controlled, but also some 20 and 40 rouble notes entirely uncontrolled. When Bokhara asked for Kerensky money the Bolsheviks sent this uncontrolled stuff down, and the bazaar was full of people carrying about large rolls consisting of sheets of twenty or thirty of these notes. Twenty-five million roubles of this paper was sent to Bokhara in a few days, when naturally the traders became suspicious of it, though they had been quite prepared to take small quantities as change. The Bolsheviks then accused the Bokharans of breaking their promise to accept Kerensky money.

The Amir of Bokhara lives in a palace, Sittar Mahassar, about 2 or 3 miles outside the town, and nowadays never enters the city. He is always attended by the Kaznachei, or finance minister, who is the minister who has the greatest personal influence with him, while the Khush Begi, who lives in the Ark or fortress in the city, has chief executive power in the State. The Government, although absolutely autocratic, is very much in the hands of the Mohammedan clergy, and as a matter of fact the Amir is very far from having unlimited power. An important officer is the Kazi Kalan, or chief justice, who was frequently seen riding in the streets with his spare horses all gorgeously clothed following behind him, and preceded by a man on horseback carrying an axe as a sign of office. Official couriers also attracted attention by carrying their passport bound in their turban for all to see. Troops could be seen marching through the streets; they gave the impression of extreme inefficiency coupled with complete confidence. The officers wear Russian badges of rank. I once saw a captain playing a fife in the band. The generals are

invariably respectable-looking old men with long white beards, and are preceded by about a dozen mounted men carrying white wands. All ranks are plastered with numerous medals and decorations. The troops always sing as they go; a favourite song is begun, "Amir Baba, the Amir is our father." Another which they used to sing in Russian in Kagan, while the Bolsheviks from the town looked on and laughed, was "Our General is a brave man and does not fear the Bolsheviks."

Bokhara city has always been famed for its fanaticism, and at the gates of the colleges and mosques may always be seen students arguing (in loud tones for the benefit of the passers-by) about knotty points of their religion.

Every one in the city must be in their houses at dusk, and the streets are paraded at night by patrols of police, who carry a drum which they beat as they go along to scare away thieves and robbers. The city is surrounded by a ruined but still strong wall about 7½ miles in circuit. One day when going for a walk on the wall I was arrested by the police on suspicion of being a Bolshevik spy, inspecting the city's defences, but I was released when I met a man in the street who knew me, though of course the police had no idea who I really was. Photographing in the city was forbidden, but from the roof of my house I managed to take a few pictures, and also some on the city wall. The houses of the city are very densely packed together, and there are no open spaces or gardens, except for a patch of reeds near the city wall, in which one day I put up a pheasant. A curious thing about Bokhara is the absence of sparrows. It is the only large city that I know where this bird is never seen, though it is of course common in the surrounding country.

The weather was quite hot in the daytime in October, but at the beginning of November frost began, and we had a fall of snow. Life in Bokhara was pretty dull after the novelty had worn off. We used frequently to go to eat *Shashliks*; these are similar to the Indian *Kabab*—small pieces of mutton on iron skewers, which are cooked while you wait, over a trough containing charcoal which is kept glowing by a hand fan. They are eaten with bread, onion, and a little pepper and salt. Another diversion was the bath. You enter a large upper room, very much open to the sky, where you undress and wrap yourself up in towels and descend to the hot underground room like a Turkish bath. Here, after waiting a few minutes, you are taken to another room less hot, and a man massages and pummels you and cracks all your joints, and finally stands on your back, which he slowly massages with his feet, using his full weight. It is hard not to laugh at what one must look like, but the solemn white-bearded Sarts treated it like a religious ceremony.

One day I visited the prison and gave some money to the prisoners. I had heard a great deal about this prison, but the men I saw seemed as happy as they should be, and were sitting on nice dry clean mats. The damp dungeon where Conolly and Stoddart were kept in 1840 to be

devoured by sheep ticks is, I believe, still in use, but I was not allowed to see it.

During my stay in Bokhara several large parties of Austrian prisoners arrived, who had travelled on foot from Kokhand, taking three months on the journey. The Soviet government would not allow the prisoners to return to their homes, and some of them had not seen their families for more than six years, having been captured by the Russians in their big successes in Galicia in 1914. They were in an absolutely destitute condition, having no money and insufficient clothing, while many were suffering from wounds received in the war and frostbite contracted in Turkistan. Although I could not disclose my identity to them, I visited them and helped those who were sick. It was impossible to assist all, and the Bokharan government refused to do anything for them. They are doubtless still there. One was a Serbian sixty-seven years old, who told me that the Austrians mobilized *all* their Serbian subjects, as they were afraid of disturbances in the districts inhabited by Serbs.

Preparations for departure included the purchase of horses for the long ride across the desert. The purchase of a horse in Central Asia is done with great ceremony. The would-be purchaser rides the horse up and down the bazaar to test the paces; he then dismounts, and the dealer and purchaser sit opposite each other on the ground, while the friends of both parties gather round. They then hold hands under their long sleeves and bargain by making signs with their hands, so that the spectators cannot tell what prices are being named. This system is also followed in Tibet. When a price is agreed on the parties rise, and all their friends congratulate them.

For food we carried Russian *sukhari*. This is ordinary leavened bread dried in the oven. It keeps indefinitely, and though very hard can be eaten when soaked in tea. We also carried salt, tea, sugar, and raisins, and a little fresh meat for the first day or two. Later a Persian showed us how to fry lumps of meat in fat with a good deal of salt, which kept good a surprisingly long time. Each man carried a leather water-bottle hung on the pommel of his saddle, but we carried no water for the animals.

Having purchased our horses and collected our food, we left one night after dark. We had to cross two danger zones. First, the main Transcaspian railway near Kagan, and secondly, the Khushk–Merv line and the Murghab river, which was in Russian territory. There was also the possibility of meeting Red Guards on the Persian frontier.

Although the area of Bokhara State is large, some 85,000 square miles, a good deal of this is desert. The central part near Karshi is the more thickly populated, while the oasis surrounding Bokhara City itself and the banks of the Zarafshan river also contain large numbers of hamlets; but the western districts, except for the banks of the Oxus, are uninhabited desert and steppe.

Our party consisted of about twenty all told, including guides, but we only had seven rifles. We all wore the large Turkoman sheepskin hat, and threw over our clothes a Turkoman cloak, our object being that if seen in the distance we would be taken for a wandering party of Turkomans, though of course a closer inspection would have revealed that we were not what we seemed. Our first night was spent at the edge of the oasis. The next day we started on our monotonous passage of the waterless steppe. We had to cover some 40 miles to the first well, and evening came on with heavy clouds and complete darkness when we were still 4 miles off the well. It was impossible to travel over the desert in the dark, and we soon lost the track, and sat down to await daylight, without water. Very soon, however, rain began, and we all spent a thoroughly miserable night in the open. At daybreak we found that we were actually on the road all the time, and we followed it to the well and watered our thirsty horses. The second day we only covered 26 miles, as we had spent some considerable time drying and feeding at the well. The third day brought us to the town of Burdalik on the Oxus.

Here we remained a couple of days. The people were very good to us and cooked sheep in our honour. The oven was peculiar: a high mud cone in which they burnt brushwood to heat it. This was then taken out and the whole sheep hung in it on green willow withes, and the top covered over. In a short time it was cooked and given to us.

There is a Beg at Burdalik who is Governor of the district. Once a day, in the morning, all the heads of the different branches of the administration have to report to him, being ushered in by officials with white wands. We were told that a similar ceremony is performed daily in the palace at Bokhara when all officers have to report to the Amir. We looked into the lock-up where a few prisoners were sitting on the ground with one leg in a stock which passes down the middle of the room, while their necks are all chained together. Two of the prisoners were to be executed the next day.

The population is Turkoman, who for the most part live a nomadic life in their round felt tents. They are so accustomed to this form of abode that when they adopt a more sedentary life they build reed huts of the same shape and size as their tents. They keep large flocks of the Karakul sheep, from which is obtained the skin we call astrakhan. The ordinary sheep of the country is fat-tailed, but the Karakul has a long thin tail. The price of these lambskins in Bokhara was 100 roubles a piece, though very much larger sums are paid for specially good skins.

On leaving Burdalik we were told that at that time of the year—December—we should find people camped at all the wells, who would sell us grain for our animals and help us to draw water. This would mean that we could travel without camels, which are very slow. The ropes to reach the deepest wells weigh so much that a pony cannot carry them. We were for the first few days disappointed in this, as we found all wells

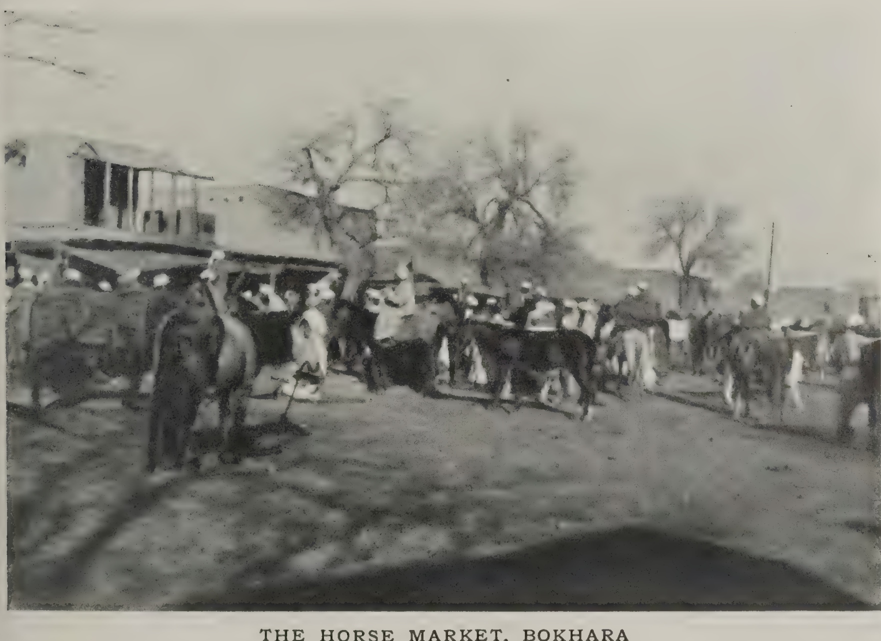
deserted, and at one time the position appeared serious, as our guides confessed they were lost and we had brought insufficient food for ourselves and our animals.

At one place we had passed a deserted encampment where we found rude shelters made of saxaul branches, with, to our delight, grass wedged in to keep out the wind. This gave our animals an unexpected treat. I had tried to keep a rough reckoning of our route, and calculated that we were about 60 miles from the Murghab river, the only certain place of obtaining water, and I feared that some of our animals would fail to reach this without water. Having lost the track we travelled across the desert, when we came on a path crossing our direction at right angles. One of our Turkoman companions said he could now take us to a well, though he did not know the way to the Murghab river from there. We followed him, and after 26 miles we reached a well where we were fortunate enough to find inhabitants. The water was pulled up in a leather sack by two camels, and I paced the length of the rope and made it 256 yards, and the well must have been over 750 feet deep. The two camels took about 9½ minutes to lift a skin full of water. Had we reached this well to find it unoccupied as had been the case with all the others, we could not have obtained a drop of water as we had no ropes either long or strong enough. Most of the wells we had used were between 60 and 100 feet deep, and these comparatively shallow ones always contained bitter water. This frequently becomes so bad as to be quite undrinkable when the well is abandoned. The deep ones invariably contained beautiful clear fresh water. A flock of three thousand Karakul sheep had just arrived to water, and were driven out the same afternoon; the man took three camels, a donkey and a dog, the camels carrying water to last the whole party about ten days, with the exception of the sheep, who were to get nothing.

On January 1 we had a blizzard, which deposited about 5 inches of snow, but luckily we had a hut to stop in. Usually we simply lay down on the ground at dusk and got up at daybreak, when it was bitterly cold with a hard frost. This snow was very fortunate for us, as it made us independent of wells and we were always sure of fresh water instead of the usual ration of brine, though it was unpleasant to sleep in the snow at night. About this time of year snowstorms sweep over the desert, but the hot sun soon melts the snow, and as if by magic small shoots of grass appear. It is for this grazing that the Turkomans bring out their enormous flocks of sheep. Later in the year when this grass is dried up the desert is absolutely deserted. The flocks are taken away from the well for about twenty days if there has been rain or snow, which will give the sheep an occasional drink. If the desert is quite dry they are obliged to return for water after eight or ten days.

The desert through which we travelled was covered with small bushes called *saxaul*, which thrives with very little water. It burns very well, and

PARTY OF TURKOMANS IN THE DESERT NEAR THE RIVER MURGHAB



THE HORSE MARKET, BOKHARA

WELL IN THE DESERT EAST OF THE OXUS

CROSSING THE OXUS AT BURDALIK

was the chief fuel supply for the railways of Turkistan when they were cut off from the Baku oil. The appearance of the desert was that of a stormy sea frozen solid, the waves or hillocks being 10 to 20 feet high in most places, and the distant horizon appearing absolutely flat.

Animal-life there was none at this time of year, but further to the west in the neighbourhood of the Murghab river there were numbers of gazelle and a few larks and many rats or marmots, while the shells of tortoises everywhere testified to their presence, though at the time of our journey they were hibernating. We also saw a few sand-grouse, and on the Oxus river were geese and ducks and pheasants in the bushes on the banks. At Burdalik we met a hawker who had just killed two pheasants.

The desert is infested with bands of Turkoman robbers, but our party was large enough to be safe from attack, though had it been known that we were mostly unarmed we should probably not have been unmolested.

All travellers agree that the Turkoman is the most persistent robber. He rides about his desert from well to well on his wonderful pony and attacks and plunders all he meets. The ponies are really marvellous. They have several well-recognized breeds, but the quality which they require and which all possess is that of being able to carry a light weight for very long distances without food or water at about 5 or 6 miles an hour; in other words, they would be ideal for mounted infantry work, provided that the soldier does not insist on too many comforts and can travel light. In Bokhara they told me of a Turkoman who had just killed a Bokharan official at Karakul and had fled to the desert. I said it would be easy enough to catch him, as they had only to watch all the known wells and they must get him soon. They said that this did not follow, as he had trained his pony to live on mutton fat, and if this is done a pony can go two months or longer without water. Although one cannot believe all one hears, we had experience of their wonderful endurance. After watering, Turkoman horses are always galloped for two or three minutes even after the longest and most tiring march. If this is not done they say they get ill and frequently die. I bought eight ponies in Bokhara for 35,000 roubles which carried us through to Meshed, a distance of close on 600 miles.

The whole nomad Turkoman population lives in constant fear of robbers of their own race. This was exemplified on several occasions. We were a party of about twenty-five, and on approaching one well we noticed a man riding hard a mile or two on our left. He was soon hidden by a fold in the ground, and presently we came in sight of the well a mile off. A single man rode out to meet us, and we sent one man on to speak with him. It turned out that the man we had seen thought we were a party of robbers and rode in to warn the people at the well. They, on receiving the news, loaded their rifles and lined the walls of the enclosure and prepared to resist, but sent one of their number forward to make sure before any blood was shed. We sent their envoy back, and presently he

signalled that it was all right and we rode up. We then discovered that the people at the well were themselves noted robbers, but the size of our party frightened them. We, however, divided the night up into watches, and took it in turn to have three of our number watching all night. These people had some fine Persian greyhounds which they use for catching gazelles. They told us that they can only catch gazelles when they are thin, as when fat they cannot get a grip with their teeth.

On another occasion, after crossing the Murghab river, when we were very short of food we came to a well at dusk and found one Turkoman drawing water. We asked where his camp was, and after some prevarication he said it was about 2 miles off. We were very short of food, so made him lead us to them in the hope that they would sell us something. When we got in sight of the camp fires he made our party halt while I and an interpreter accompanied him. When about 50 yards off he asked us to stop while he went forward to explain. The Turkoman then shouted that we must move further off as they were afraid, and they would then send a man to us with food. They then called out that they would give us nothing, and that they had loaded their rifles and would fire if we did not go off at once. We were obliged to comply, and the next day we met a man who said that they were a party of robbers, who, thinking we were another party who would attack them, had moved off that night as soon as we had left.

Later we came on a camp of Turkoman shepherds. We had had practically nothing to eat for several days except the ponies' food, which we either parched or boiled according to the individual taste. They were terrified at seeing such a large party, and thought that the worst had happened. However, they soon saw that we meant no harm. These men sold us three sheep, which we ate on the spot, cooking *shashliks* on the cleaning rods of our rifles. They also made us some good fresh bread by laying the unleavened cake on the hot earth after scraping away the fire and covering it with glowing ashes. This was cooked in about twenty minutes. We asked these people to sell us some flour, but they excused themselves, saying that they had only enough left for their own use, but that at a well some 9 versts on we should find all we wanted. We left them, and on approaching the well we found to our dismay that it was quite deserted. We found out that the people at the well had seen our large party ride up to the men who were out grazing their flocks, and, thinking we were a gang of robbers, they had decamped to a man, and intended to live some distance off in the desert and not return to the well until we had moved off. The above incidents will show the continuous dread of robbers in which the Turkoman lives.

We crossed the Murghab river at night. We were in danger of being intercepted by Bolsheviks here, as they patrol the Khushk–Merv railway line which runs near the river. We found the river about 20 yards wide, with steep banks, and our ponies were forced to swim. We were now well out of Bokhara territory.

The western Bokharan frontier is an undefined line in the desert some 5 or 10 miles to the west of the Oxus, but Bokharan subjects graze all over the desert between the Oxus and Murghab rivers, and the control of the Russians over their subjects in the Murghab valley is very loose.

From the Murghab river we had several days more of desert travelling to the Persian frontier, where we had a brush with a Bolshevik patrol, and it was with a feeling of overwhelmlng relief that we trod on the soil of Persia and were free from the tyranny inseparable from Soviet rule.

The PRESIDENT : We have listened to a long list of Fellows who have been elected, but there was to have been one elected whom I am sorry to say, since he was proposed at our Council meeting a fortnight ago, we have heard has died during a journey on the China-Burmese frontier. I allude to Mr. Reginald Farrer, and we do greatly deplore the loss of this traveller, because he was a man of exceptional refinement and culture, who minutely observed and very carefully recorded and described the natural features of the countries through which he was passing. He also had a peculiar knack of getting on with all kinds and conditions of people, including Government officials, and overcoming those human obstacles which are often the most serious obstacles with which a traveller is confronted. Only a fortnight ago I had a letter from Mr. Reginald Farrer dated from the borders of Burma and China in which he described his present two years' journey upon that frontier, and outlined another travel on which he had set his heart, and in which he had asked my help so far as I could give it, and that was to go to Lhasa in Tibet. We very much regret his loss, because I looked upon him as the forerunner of a new type of traveller, who, taking advantage of the pioneering of his predecessors, would have brought back to us those cultured descriptions of the beauties of Nature and of plant, animal, and human life in the countries through which he was travelling, which I consider are the very flower of geographical knowledge.

Our lecturer this evening is Major Bailey, whom we all know, and we are specially beholden to him, because for many years past he has been suffering ome very severe hardships and strain. He was wounded in the battle of Ypres and in both legs in the Gallipoli campaign. He served afterwards in Baghdad, and from there he went to Central Asia, and was in hiding and eventually escaped from the clutches of the Soviet rule in Turkistan. He is, therefore, well entitled to a good holiday, but he has come here this evening to give an account of his experiences in Bokhara, and we are glad to welcome him.

Major Bailey then read the paper printed above, and a discussion followed.

The PRESIDENT : Sir Michael O'Dwyer, the distinguished Governor of the Punjab, is present. To him is due as much as to any living man that the Provisional Government of India of which we have heard never came into actual being. He has been to Bokhara, and knows something also of this great Indian Prince who was to rule in India, and perhaps he will very kindly give us some remarks about the lecture.

Sir MICHAEL O'DWYER : To-night I have had the honour of being the guest of the Geographical Club, and in that moment of enthusiasm which follows a good dinner I rashly promised the President to say a few words on the subject of the lecture. The President's request was based on the fact that I was once in Bokhara ; that is many years ago—as far back as 1896, and one's memory of

those times is getting blurred. But the admirable lecture which we have just listened to, and the excellent slides we have seen, recall a few associations of the days when I was in Bokhara. The memory which stands out more vividly than any other is this. I remember on a summer's evening early in May 1896 being on the railway station at Kagan, close to Bokhara, where there was a brilliant crowd assembled. The Emir of Bokhara was departing in a special train with a splendid retinue to attend the coronation of the Tsar of all the Russias at Moscow. A few months afterwards, being in Moscow, I had the opportunity of seeing again, not only the Emir, but the Tsar at the Coronation ceremonial, and now the two are associated in our minds with the same tragic fate which both have met at the hands of the Bolshevists. The Tsar has lost his Empire, life, and all near and dear to him, and the latest news of the Emir of Bokhara is that he is a fugitive from his capital, that his kingdom is in the hands of the Bolshevists, and the great city of Bokhara, which was the centre of Islamic civilization and culture and the great trade emporium of Central Asia, has now become a prey to rapine and bloodshed. One regrets the downfall of a great city like Bokhara. One hopes it may shake off the blight of Bolshevism and recover its pristine glory, which has won for it the title of Bokhara the Noble (Sharif). Most of us here in England may say it is a long way off and does not particularly interest us; but apart from the political significance of the events which have made the Bolshevists dominant in Bokhara, events which cannot but react on Persia, Afghanistan, and India, this downfall of the Emir and the native Government has also very considerable economic importance. Bokhara is the great mart of Central Asia, and was a great outlet for British and Indian trade. The few days I spent in its bazaar I was astonished at their great wealth—to my mind, far superior to anything in India. The products of Persia, Afghanistan, of Northern India, of Western China, of Europe were all collected there and were being freely exchanged under conditions of order and security; for the Bokharan Government, to its credit be it said, during all the centuries during which it maintained its independence, was conspicuous for two great things. In the first place, it always protected trade and travellers, and, in the second place, it maintained a reliable gold currency which had never been debased, and which was accepted with confidence in every market from Nijni Novgorod to Kabul and Kashgar, if not Further China. When you note these two facts, the great protection given to travellers which attracted traders from every quarter of Central Asia, from India, Turkey, and Russia to Bokhara, and the stability of the coinage, you have the explanation of the wonderful success of Bokhara as a commercial capital. Major Bailey has told us of the great number of Jews and Hindus there. When I was in Bokhara I went to see the Indian bazaar. I found a large colony of Indians, quite happy and prosperous, and they were very glad to meet one who could speak their language. Directly I appeared they produced the Anglo-Indian national drink—whisky and soda! I believe at that time it was the only place in Central Asia east of Baku, if not of Tiflis, where you could get a whisky and soda; but my Indian friends at once produced it and the Russian cigarettes. It was interesting to note where they came from. There were a good many Peshawar Mohammedans amongst them, but the great majority were Hindus from Shikarpur in Sind, and there were a certain number of Sikhs and other Punjabis. I got into conversation with one fine Sikh and asked him how long he had been there. He was a little reticent about answering, but in the end I succeeded in getting from him that he came from a village near Amritsar and had been twenty-two years in Bokhara. I said, "Have you

no desire to go back?" All the others return every four or five years. He shook his head, and finally said, "Tell me, is Warburton Sahib still there?" Mr. Warburton was a famous Punjab police officer whom you find immortalized in 'Kim' and others of Kipling's books. I met Mr. Warburton some years later in India and explained how his name and fame resounded in distant Bokhara, and it turned out this Sikh was one of the men who organized in 1873 the murder of the Mohammedan butchers because they killed the sacred cow. Mr. Warburton got to the bottom of the conspiracy, and some were hanged, but this man got away and never dared to return.

Major Bailey has explained very clearly how Bokhara is dominated from Russian territory. It lies between the Transcaspian province on the west and the Turkistan province on the east. One means by which Bokhara is throttled lies in the railway which runs through those provinces and Bokhara being entirely controlled by Russians, and the other (and, so far as I could ascertain, the more effective method) of strangling Bokhara is the possession by Russian Turkistan of the headwaters of the Zarafshàn, which means "The Gold Scatterer"—that is, the waters of this river are so fertilizing that they produce the magic effect of gold. It brings down from Russian territory enough water for the irrigation on which Turkistan and Bokhara depend, but the Russian authorities control the upper waters and the supply below, and they sometimes say, "We want all this water for our own territory." Bokhara is particularly dependent upon the waters of this river, because so far as I could see the soil was in places steadily deteriorating. Wherever you watered from wells the water was brackish. The result was that the ground was covered with salt, and the only way of working off this was by copious inundations of river water. As I have hinted, Bokhara was the meeting-place not only of men engaged in honourable business, trade, and commerce, but also the refuge of some rather shady customers, criminals and political conspirators, and Major Bailey has told you of one of these who, though passing as an Indian prince, was plotting against the British Government. I saw something of the other side of the movement in the Punjab, and I do know that the information which Major Bailey brought back as the result of his thrilling adventures has been of enormous value politically as throwing much light, not only on the doings of the Bolshevists, but on the intrigues of all the various anti-British factions which are gathered under the wings of Bolshevist Russia in Bokhara and elsewhere. This man Mahendra Partab was perhaps the most important of those plotters. He is a man who owned very large landed estates—now sequestrated—in the United Provinces. He is married to the sister of one of the ruling princes of the Punjab. In his early days he developed a dreamy idealism which characterizes a certain number of the Indian revolutionaries. He read everything Tolstoy wrote and adopted those notions of Tolstoy's which to my mind have prepared the way for Bolshevism in Russia and indirectly for a similar movement in India. When he left India his sole idea was to bring about the downfall of the British Government, and prepare the way for the restoration of the mythical golden age of Hinduism. To do this he got into touch with the Germans at Berlin. He was introduced to the Emperor, I believe, as a representative of the Indian princes, and made a member of the Council in Berlin which during the war dealt with Eastern affairs. It was through him, and another man of the same kind, an Indian Mohammedan named Barkatullah, that the Germans endeavoured to foment rebellion in India. There were several other seditious Indians helping the Germans, but these two men had a certain amount of influence in India, and they deluded the Germans in Berlin into believing they could bring about

a rising there. You will be glad to hear, as showing the spirit of loyalty among the Indian princes, that whenever Mahendra Partab sent letters to his wife, who is the sister of an Indian prince, this prince at once took possession of these letters, and without opening them sent them on to Government. He also insisted that his sister and her family should leave the estates of and sever all connection with this disloyal rebel, and soon after that I think his property was confiscated. One other sidelight on Bolshevist methods came to my notice before I left the Punjab. The Bolshevists having established themselves at Bokhara sent their agents down to Kabul. A notorious Bolshevist leader appeared there named Bravin. It was interesting to see how clever they were in selecting the right man for the work. Bravin had been attached to the Russian Consulate in Calcutta for many years and made himself very well known there, and when the Bolshevist movement spread he was one of the first selected for special service in the direction of India. When the Afghans invaded India last year on the invitation of the Indian sedition-mongers and threatened all our North-West Frontier, their Generalissimo, Nadir Khan, had a big force at Thal in our territory which was smashed up by General Dyer. The Generalissimo fled in hot haste and left a lot of his papers behind him, including a very detailed plan prepared by Mahendra Partab and Barkatullah for the provisional government of India. As far as I remember, it got over the sectarian difficulty mentioned by Major Bailey of Mohammedan domination by sharing the position of the President of the Indian Republic between one Hindu and one Mohammedan! I do not know that there is anything else except I am sure we all hope that the old historic capital of Central Asia, which has filled so large a part, not only in the political but the commercial world, may be raised again to its pristine greatness. Bokhara has always had a keen demand for the best kinds of English goods. When I was in Bokhara the Russians had brought the Bokharan state within their trade system and imposed very heavy taxation against all goods of non-Russian origin. The Bokharan is as particular about his clothes, especially his head-dress, and cultivates the latest fashions in headgear, as an English or Parisian lady. The Russians had hoped to exclude English goods by putting on a very heavy tariff, but the Manchester muslin was of so fine a quality that no Russian loom could approach it, and the Bokharans at that time were paying fabulous prices for Manchester muslin smuggled in through Afghanistan, because they found it much finer than anything they could get from Russian sources. Bokhara under Bolshevist rule is, I believe, now entirely cut off from British and British Indian trade, and the Indian press reports that the city has been completely looted, and the merchants have all fled. Let us hope that this is only a temporary eclipse.

The PRESIDENT: Sir Aurel Stein, who made those wonderful journeys in Central Asia and more particularly Chinese Turkistan, is here, and we should be very glad if he would give us a few words.

Sir AUREL STEIN: It is a great honour to be called upon to offer any remarks after this fascinating lecture which we have heard from Major Bailey, telling us of wonderful adventures such as one expects to read of only in distant history, and after the most striking observations which my old chief and friend Sir Michael O'Dwyer has just given us on what is a very recent past in India and Bokhara. It is true I have been in Bokhara territory. But though it is only five years ago that I travelled through the whole length of the mountainous part of its territory, I feel as if it were old history. Four years ago there was still the Imperial power of Russia smoothing the way for

me in the service of the Indian Government, making things in Bokhara as easy for me as in any Indian native state; and now we have had to learn of the wholly different conditions under which Major Bailey had to do his work.

I was travelling there in 1915 for scientific purposes. I wanted to see as much as I could of a very important ancient passage land which had once seen most of the intercourse between the classical West and the Far East. Sir Michael O'Dwyer has been rightly putting special stress upon the important fact that Bokhara from the earliest times has been one of the great commercial centres of Asia. This must impress any experienced observer of modern conditions in Bokhara itself. If reference to ancient history were needed, I have only to mention that Sogdiana (which was the old name of the territory which you have so often seen here on the map between the Oxus in the south and the Sir-darya or Yaxartes in the north) was a chief place of interchange between three great civilizations. I mean the Hellenistic civilization of the Near East which had penetrated through Persia; then the civilization of India which had spread northward with Buddhism; and thirdly, the culture, trade, and organized power of China, which for more than one century before and one century after the time of Christ, and again in the seventh and eighth centuries of our era, had maintained a dominating influence over great portions of Central Asia.

I shall not attempt now to give you indications of the many interesting facts we know about the part which Bokhara had played in the history of innermost Asia. I shall mention only one fact which will be of interest to you as students of geography: it illustrates how physical conditions determine the character of the population far more than race or language. We have heard here interesting accounts, and have seen too on the screen glimpses, of the present Turkomans, who have now happily resumed that rôle of nomadic robbers which the beneficent repression of the quondam Russian government had denied to them for a short period. In that very territory, long before the Turks had appeared on the stage of Central Asia, there had lived a people wholly distinct in language and race, but doing exactly the same things. They were those tribes of Iranian speech but nomadic habits whom the peaceful settled population of Persia knew and dreaded as "Turanians." Considering their ancient reputation it was quite amusing to me in Bokhara City to have to put up in a kind of hotel which called itself the "Turanski Numer." It was evidence how the term *Turan* had been brought to life again by the sort of Pan-Islamic propaganda that went on long before the war.

The historic rôle of Bokhara, I am sure, has not changed in essentials since those days when it witnessed the interchange of Persian, Chinese, and Indian civilizations, and I believe, whatever misfortunes that great city has recently undergone, geographical facts will re-establish its importance within a not very distant period. But I also believe that no change in the controlling power will ever dispose of the facilities which the desert, of which you have seen so many photographs, offers to people on its borders. The same Turkomans who now have taken again to the part of robbers had since the Russian occupation of Transcaspia in the seventies of the last century been obliged to content themselves with making plentiful money by cotton cultivation and the production of wool. Yet that period of some forty years of peaceful prosperity has not killed the ancient fascination of another and more congenial life which such ground must foster.

I wonder whether the present conditions will continue long enough for us to see demonstrated afresh the wonderful performances of the Turkoman

pony. When I was passing down the Perso-Afghan border in 1915—under conditions which, I may note in passing, were not quite those of peace—I had the good fortune to fall in with three Turkomans of the old type, then in the service of the British Consulate-General at Meshed. These men were employed to look after the Indian mail-bags passing through Afghan territory. They told me interesting details as to how those raids which once brought bands of Turkoman raiders right down to Seistan, some 400 miles off, were planned; how the ponies used for them had been trained, etc. I regretted then not to have had enough time for collecting more information on the subject. If conditions continue as at present, it may soon be possible to hear similar stories of modern raids.

There is one more matter with regard to which ancient history can be studied afresh on the same ground. Bokhara is a typical "terminal oasis," to use the proper geographical term, and such oases which derive their irrigation from the terminal course of a river are particularly dependent for their prosperity upon the maintenance of a firm government, not only in their own areas but also higher up. Whenever political troubles or similar disturbances lead to the neglect of, or interference with, the irrigation system at the canal head a terminal oasis is bound to undergo a great crisis, which, on such ground as Chinese Turkistan offers, may eventually result in complete extinction.

I have often been asked for my views as to how those ancient oases of the Tarim basin, now buried in drift-sand, which I had the good fortune to explore, had originally come to be abandoned. In reply I have always emphasized the limitation of the available archæological evidence. This could indeed prove within which period those oases were abandoned, what kind of civilization once flourished there, etc. But archæological indications in the absence of historical records do not suffice to show what was the direct cause which first started abandonment.

The human factor is a very complex one and liable to be affected by changes correspondingly varied in character. Among the possible causes leading to the abandonment of oases the theory which attributes it to "desiccation" also deserves careful consideration. It has found much favour since Prof. Huntington's very stimulating publications have made geographers and others familiar with the idea of pulsatory changes of climate leading to far-reaching historical effects.

It may be safely assumed that since those oases in Chinese Turkistan were abandoned to the desert the climate has become more arid, or anyhow the amount of water available for irrigation much reduced. But this does not prove that it was "desiccation" itself which caused abandonment in the first instance. A *post hoc* does not necessarily mean a *propter hoc*. I am unable to accept that assumption as a "working theory," because I realize the peculiar complexity of the human factor, and also because it is impossible to test such a "working theory" by experiment. This may be unfortunate; but in this respect geography, like history, differs from exact sciences.

If then we cannot have experiments, it must be of additional interest to observe that our own time supplies evidence that the area of Central-Asian oases like Bokhara can be affected very closely by political changes. From reliable information I received, it appears that the maladministration attending the present Soviet *régime* in Russian Turkistan and the consequent neglect of the canal system has led in Farghana to the abandonment of much land in the lower portion of the hitherto rich and closely cultivated tracts. Now, I suppose if I came back myself to that ground after two thousand years and found there

archæologically datable remains of settlements abandoned at the present period it would be so easy to come to the conclusion that this abandonment must have been due to climatic change bringing about increased aridity. Suppose that no records of the present period survive two thousand years hence, and it will be impossible then to prove that this conclusion was wrong and that the abandonment had been the direct result of a great political upheaval. Whether any scientist is prepared to explain the present period of upheaval on this globe of ours as due to increased aridity, I do not know. Anyhow, here is a case where the history of our own time aptly illustrates the difficulty facing the critical student when he is expected to judge of the causes of past events in the absence of actual records.

I wish only to add that all Major Bailey has told you and shown on the screen is indeed most instructive, not only to the geographer and the student of Eastern humanity, but to the historian as well. In geography we cannot make experiments; but here contemporary developments strikingly show us how historical changes affect all the aspects of human life with which geography is dealing.

The PRESIDENT: Colonel Yate was engaged thirty-five years ago in delimiting the boundary between Afghanistan and Russia in that part over which Major Bailey escaped.

Colonel C. E. YATE: I have never been in Bokhara myself, but I well remember coming to the frontiers of Bokhara and being received by a Bokharan Court of Honour, and I must confess I can endorse what Major Bailey has said when he described the Bokharan soldiers as giving the impression of extreme inefficiency. I never saw such an extraordinary collection of men in their yellow leather trousers over long top boots and most extraordinary arms and weapons; the music and band and whole turn-out were a sight I shall never forget. I know the part of the country south of Bokhara stretching from the Oxus to the Persian frontier, where I spent several years in the delimitation of the Russian and the Afghan frontier. After some two years in the country with the Afghan Boundary Commission under General Sir Peter Lumsden, I was finally sent out to build up all the boundary pillars in that whole tract of country. I followed Major Bailey's journey across the desert with the greatest interest. I remember when, after travelling through the desert, we came to the end of our journey on the banks of the Oxus, the Russian officers and ourselves embarked on a boat and floated down that river till we got to the railway, and then went on to Merv, and so home. We had a wonderful time travelling down the Oxus, and we never stopped day or night. I remember we had certain food in tins with us to eat, but the Russians had nothing to eat but a sturgeon, and that we found so good that we all fed for days on it and never touched the other things. When Major Bailey described his crossing of the Oxus I was wondering how he would get across. We saw the picture of the boat he crossed in, and apparently, I understand, they rowed the boat across. At Kilif I remember seeing a similar ferry-boat to the one shown, but that boat was drawn by a couple of horses. They were harnessed to the boat and went into the water, and a man stood in the bows with a whip, and those horses swam across. It was a curious instance of what horses can do. I never dreamt till I saw it that a couple of small horses could take a big, heavy boat across such a deep and swift river nearly half a mile in breadth. I had to demarcate the boundary from Meshed to the Oxus, and had to construct all the pillars as marked on this map. Every one who has travelled in these regions has vivid recollections of the bitter water and salt wells referred to by Major

Bailey. I had to live for a fortnight once on a well of Epsom salts, and I well remember it! Another thing that I sympathized with Major Bailey in was the snowstorm he told us of. I remember starting one April day with thirty camels laden with water out into a waterless tract of desert. That night a most awful blizzard came on, and by the morning there were a couple of feet of snow. The muleteers had left the corn for the mules behind because the young spring grass was up, and the animals would look at nothing else. The snow came down in this awful blizzard, and though the horses and mules tried to get down through the snow to the grass, they could not do it, and were very near starving. There it was that I came to realize what a splendid guide a Turkoman is. He seemed to know every well and road in the country, and carefully guided us through the storm to a place where we could find wood, light a fire, and get some food both for man and beast. I have ridden hundreds, I may say thousands, of miles with these Turkomans, and they never once failed to guide me right. Sir Aurel Stein has told us of the Turkomans who were on the mail line between Meshed and Herat. They were there with me when I was Consul-General at Meshed. All those Turkomans refused to go back to service in Russia when Panjdeh was taken by Russia in 1885, and asked to become British subjects. These men, I believe, are still in the British service, and employed on the same postal duty between Meshed and Herat, and I can only say they have always been most extraordinarily faithful followers of the British Government. They were robbers, it is true, and I suppose when the opportunity occurs they always will be robbers. They used to raid the whole of the Persian frontier in olden days, carry off slaves, and keep them. Whether this will break out again, as has been suggested, I cannot say, but we on the Afghan Boundary Commission found them capital fellows, and I certainly have the most pleasant recollections of them all. While on this frontier we found a most beautiful species of pheasant. When Colonel Peacock of the Engineers and myself were demarcating the boundary, we used to go out with the Turkomans and ride these pheasants down, as after two or three flights they used to hide in the snow, and their tails betrayed them. We brought home half a dozen, and they were declared to be a new species and named *Phasianus Principii*, or Prince of Wales' Pheasant; but it was found that they would not breed in captivity. They were magnificent birds. I was at Panjdeh at the time when the Russians drove out the Afghans. Within the last few days we have heard that the Afghans have now some troops in Merv, but what is going to happen there we none of us can say. Although the Afghans are in Merv, we hear that the Bolshevists are in Kushk, to the south of it, and consequently I do not think that Merv can be now the frontier of Afghanistan, as I have heard said, because whatever Government is in power in Russia, their hold on Central Asia depends on that one line of the Transcaspian railway, and I cannot think any Government in Russia will allow the Afghans to cut that line. I was at a lecture the other day by a very well-educated young Afghan. He dwelt on the advantages of a Mohammedan federation in Central Asia between Afghanistan, Persia, and Bokhara. Now what has become of the Emir of Bokhara none of us know; he has been driven out by the Bolshevists, and is in flight. There is no love lost between the Usbegs of Bokhara and the Afghans as a rule, but whether they will join up now under the terrible threat of the Bolshevists is a question that has still to be settled. There is also no love lost between the Afghans and the Persians. The Afghans overran Persia years ago—they may do it again. We hear a great deal now about the defence of Persia from the Bolshevists, and the few troops we have in North-West Persia

What will happen there none of us can say. Whether the Persians will accept our agreement or not none of us know. I cannot help thinking that if we do come to a Mohammedan federation in Central Asia it would conduce to stability in those regions, but none of us can say what will happen there. We can only hope that the Afghans will see wisdom, and that they will turn to the British instead of to the Bolshevists, and that we shall not have any fresh trouble with them as we had last year, when they so outrageously and wantonly attempted to invade India.

The PRESIDENT : I am sure we should wish to congratulate Major Bailey upon his wonderful escapes and the great resource which he showed in dealing with critical situations. He is the most remarkable man I know of for getting himself into nasty situations and getting himself out of them again.

MODERN DEEP-SEA RESEARCH IN THE EAST INDIAN ARCHIPELAGO

Prof. G. A. F. Molengraaff, of Delft

Read at the Meeting of the Society, 7 *June* 1920. *Map following p.* 152.

SUBMARINE topography all over the world is much simpler than the topography of the subaerial portion of the globe. This is, at least near the continental borders, evidently the consequence of the covering or blanketing influence of continuous sedimentation on the relief of the sea-bottoms contrasting with the carving and sculpturing influence of never-ceasing erosion on the land surfaces. Wherever this rule does not hold good the submarine topography, not yet being obliterated by sedimentation, must be of recent date. A bold relief of the sea-bottom is therefore, at least near the continents, apt to indicate portions of the Earth's crust which either have been warped in recent geological time or still continue to be orogenetically active, and thus continually rejuvenate and remould the sculpture of their surface. In this paper the latter alternative will be discussed for the Australasian seas.

One of the major results of deep-sea research, a branch of science of modern date, has been the statement of the fact that the so-called mediterranean seas are, as compared with the grand oceans, characterized by a bold and diversely developed submarine topography.

Mediterranean seas are, as the name indicates, seas which separate continents one from the other; in a somewhat narrower sense the name is given to those mediterranean seas which separate the great continents of the northern hemisphere from the southern continents, viz. the Caribbean Mediterranean between North and South America, the Mediterranean Sea in the strict sense between Europe and Africa, and the Australasian Mediterranean sea between Asia and Australia.

One of the peculiarities of the topography of the mediterranean seas proved to be the existence of basins, often of great extent, separated from

the great oceans by submarine barriers or ridges of varying depths. To these basins, notwithstanding their great depths, the cold water from the abysmal portion of the oceans cannot have access. Consequently in each of those basins the temperature of the water below the deepest point of the ridge or barrier separating it from the ocean remains constant, whatever figure its entire depth may attain.

The submarine topography of the European Mediterranean Sea is known by various investigations dating from the year 1879, and our knowledge of the Caribbean Mediterranean Sea is chiefly based upon the results obtained by the *Blake* in the years 1877–1880. In the Australasian Mediterranean Sea the first deep soundings have been made with an inadequate equipment by Siedenburg in the year 1858. A small but important series of deep soundings carried out by the famous *Challenger* Expedition in the years 1874 and 1875 made known the great depths of some of the basins of the East Indian archipelago; and later a few data were added to the list by the soundings of the German vessels *Gazelle* in the year 1875 and *Valdivia* in the year 1899, as well as by those of the British vessels *Egeria* and *Rambler* in the years 1888 and 1890.

Only in the years 1899 and 1900 a well-equipped expedition, the *Siboga* Expedition, directed by Prof. M. Weber, succeeded in revealing many of the secrets hidden by the East Indian waters. By 238 soundings, made at the same number of stations, so many data were obtained about the submarine topography, that upon these and some other records mentioned above, the present Vice-Admiral G. F. Tydeman (Bibl. 22), then the naval chief of the *Siboga* Expedition, found it possible to publish in the year 1903 the first chart of the depths of the sea in the East Indian archipelago.

Additional data were obtained by later deep-sea work carried out by the Dutch vessels *Bali*, *Edi*, *and Telegraaf* in the years 1903, 1905 and 1910, the German vessel *Planet* in the year 1906, and others. Every new fact added to our knowledge of the submarine topography of the East Indian archipelago has given fresh evidence of its diversity, and proves its features to be bolder and more complicated the more they are known. At present no less than thirty larger and smaller deep-sea basins are known to exist in the East Indian archipelago. They are enumerated in the list given on p. 97, with the exception of some minor depressions of small extent. In this list are also incorporated the Andaman basin and the South China basin, although they only touch the borders of the archipelago, and do not belong to it.

To the deeper portions of the Andaman basin, the Mentawei basin, the Java trough and the Timor basin, only the water of the Indian Ocean has access, whereas the deeper water of all the other basins is connected only with the Pacific Ocean. The extensive basin of the Banda sea, and with it the Wetter trough, the Savu basin, the Flores basin, the Saleyer trough, and the Buton trough, is separated from both oceans by a rim,

Basins of the East Indian Archipelago.

	Greatest depth in metres.	*Authorities.*	*Lowest point of the rim separating the basin from the oceans.*	*Temperature of homotherm water-mass in degrees Centigrade.*
Andaman basin	4177	Investigator ?	1200	5·2
Mentawei basin	1671	Valdivia	900	5·9
Mentawei trough or Sunda trough	5214	Valdivia	—	—
Java trough	7100	Planet	5800	—
Timor Sea	3109	—	±2000	3·0
Kei trough	3565	Siboga	±1600	—
Ceram–Aru trough	2571	Rambler	±1600	—
Flores Sea	5121	Egeria	1650	3·3
Savu Sea	3758	Gazelle	1650	3·3
Wetter trough	3257	—	1650	3·3
Saleyer trough	3110	Siboga	1650	3·3
Buton trough	3335	Bali	1650	3·3
Kalao trough	2124	—	—	—
North-western Banda Sea ...	5098	Bali	1650	3·3
Central Banda Sea	5121	Challenger	1650	3·3
Eastern Banda Sea, including the Weber deep	6505	Penguin	1650	3·3
Batyan trough	4709	—	±2000	—
Gorontalo trough	3755	Bali	±1880	3·1
Sangir trough	3302	Siboga	±1880	—
Togean basin	1800	Bali	—	—
Tomini basin	2006	,,	—	—
Celebes Sea, including the strait of Makassar	5111	Rambler	1400	3·7
Sulu basin	4663	Challenger	380	10·2
Halmaheira basin	2039	Siboga	±1100	—
Mindanao trough, central portion	8500	Planet	—	—
Mindanao trough, southern portion	7243	Edi	—	—
China Sea, central portion ...	4965	Egeria	—	2·8
Palawan trough	2877	—	—	—

the lowest point of which is situated at a depth of 1600 metres between the Sulu islands and Obi Major. Over this rim the water of the Pacific Ocean communicates through the Molucca passage with the deeper water of the Banda basin. The homothermic water below 1650 metres in the Banda sea, and all the basins connected with it have a uniform temperature of 3·3° C. The Sulu basin is more enclosed than any of the others, and below 380 metres its water has no communication at all with the oceans. From that depth to the bottom at 4663 metres its water has a temperature of 10·2° C. throughout.

The deposits formed in those more or less enclosed basins have been examined by Böggild (Bibl. 2). As none of them are formed very far from land, terrigenous deposits much preponderate, and pure oceanic deposits free from terrigenous elements are absent. Nevertheless Böggild adopts the classification introduced by Murray and Renard for the oceanic deposits collected by the *Challenger* Expedition, remarking, however, that all the oozes found in those basins are more or less modified by an

admixture of terrigenous material. Thus, for instance, both blue mud and volcanic mud are called Globigerina ooze by Böggild as soon as they contain more than fifty per cent. of carbonate of lime in the form of shells of Globigerina.

The most remarkable outcome of the researches of Böggild is, that in the basins of the East Indian archipelago the percentage of carbonate of lime in the bottom deposits diminishes with increasing depths at a rate more rapid than in the oceans. The decrease in the percentage of the carbonate of lime in the deposits of those basins towards the depths is shown in the following table:

Depth in metres.	*Number of samples.*	*Average percentage of carbonate of lime.*
0–500	26	43·2
500–1000	16	38·0
1000–1500	12	31·2
1500–2000	10	32·2
2000–2500	11	24·0
2500–3000	9	25·7
3000–3500	4	23·6
3500–4000	4	8·4
>4000	14	2·1

In the open oceans Murray and Renard (Bibl. 15, p. 279) have found the relations between the depth of the sea and the percentage of carbonate of lime in the deposits to be as follows:

Depth in metres.	*Number of samples.*	*Average percentage of carbonate of lime.*
1–900	14	86·04
900–1800	7	66·86
1800–2700	24	70·87
2700–3600	42	69·55
3600–4500	68	46·73
4500–5400	65	17·36
5400–6300	8	0·88
6300–7200	2	0·00
>7200	1	trace

These two tables are not directly comparable on account of the strong terrigenous character of the deposits of the basins of the East Indian archipelago. Nevertheless they show clearly how in the basins from a depth of 3500 metres downwards the percentage of carbonate of lime rapidly decreases and soon becomes smaller than in the oceans. Whereas below 4000 metres in the basins the majority of the samples are completely limeless, and the average percentage from all the samples is as low as 2·1, in the open oceans between 4500 and 5400 metres the percentage of carbonate of lime in the deposits averages 17·36, and the practically limeless zone only commences at a depth of about 5500 metres.

Böggild—although "with strong hesitation"—applies the name "red clay" to the limeless deposits found in the deepest portion of the Celebes basin and the Banda basin, although these deposits, the carbonate of

lime being dissolved, are practically no more distinguishable from either blue mud or volcanic mud. This name is apt to cause confusion, because the red clay of the oceans has a well-marked geological character of its own, having far more than any other deposit accumulated with extreme slowness. Böggild's red clay of the enclosed basins lacks this and any other geological character of its own.

This disappearance of the carbonate of lime in the deeper portions of the more or less enclosed basins is an unexpected result. The current opinion is that the progressive solution of carbonate of lime in the oceans with increasing depths must be attributed to the influence of the cold water of the polar regions, which by the hydrospheric circulation slowly but continuously replaces and refreshes the deepest sheets of water at the bottom of the oceans. This water contains a large percentage of oxygen in solution, and thus maintains the power of the deeper portions of the oceans to oxidize organic matter. The carbonic acid freed by this process of oxidization would give the same deep water the power to dissolve carbonate of lime, and thus to destroy those descending shells and skeletons of dead pelagic organisms which are composed of carbonate of lime.

Now, in the Banda basin and the Celebes basin, which are separated from the Molucca passage and thus from the Pacific Ocean by ridges of no greater depth than 1650 and 1400 metres respectively, the deeper water of the oceans which is richest in oxygen and carbonic acid has no access. Thus, according to generally accepted views the percentage of lime even in the deepest portions of these basins could not be less, or at least not much less, than in the Pacific Ocean in depths corresponding with the lowest point of the separating ridges.

Consequently, one would expect to find in the deposits in the deeper homothermic portions of these basins a rather large percentage of carbonate of lime, 50 per cent. or more. Böggild's analyses have shown that this is not the case. Böggild looks for local explanations, and suggests the possibility of the occurrence of submarine volcanoes as sources of carbonic acid, but this suggestion is not sustained by facts.

A similar case has been recorded from a portion of the Caribbean Mediterranean Sea, which huge basin from a depth of 1200 metres downward is separated from the Atlantic Ocean. Here in the Curaçao deep* at depths of about 5000 metres limeless deposits (red clay) are said to occur, whereas in another still deeper portion of the same basin, viz. in the Bartlett deep, the presence of pure Globigerina ooze is indicated. Our information about the deposits in the Caribbean Sea, however, is scanty as yet, and I have not succeeded in finding a discussion of the quoted occurrence of red clay in the Curaçao deep. The entire

* J. Murray and E. Philippi (Bibl. 16, Map i.); J. Murray and J. Hjort (Bibl. 17, Map iv.). A. Agassiz maps the bottom deposit in the Curaçao deep as a modified pteropode ooze (Bibl. 1, vol. 1, Fig. 191).

question of the occurrence of limeless deposits in enclosed deep-sea basins appears to be as yet open to explanation. According to what has been said above, one must expect these deep sea-basins, and in general the complicated submarine topography, of which they form the most conspicuous features, to be of modern origin. Before discussing their mode of origin it will, however, be found useful also to take into consideration what characteristics modern hydrographical research has disclosed in those other positions of the archipelago, where deep-sea basins do not occur. Here an entirely different aspect prevails.

Two great shelves attached to the continents of Asia and Australia extend far into the archipelago, as has been stated by Early (Bibl. 8, p. 395) in this *Journal* as early as 1845. They are known as the Asiatic bank or Sunda shelf, and the Australian bank or Sahul shelf. The Sunda shelf is the greatest shelf known on earth, measuring 1,850,000 square kilometres. The surfaces of both the Sunda shelf and the Sahul shelf are characterized by their almost perfect evenness. The depth of the water on these banks averages about 30 fathoms (W. Earle, Bibl. 8, p. 359). On the Sunda shelf depths exceeding 30 fathoms are extremely rare, and practically are only found in the south-eastern portion, where in the direction of the Makassar strait the depth increases rapidly; and again in the north, where towards the South China Sea the depth increases very slowly. A constant depth and a perfectly even and undisturbed surface of their bottoms are the outstanding features of these shelf seas. Thus the East Indian Archipelago proves to consist of two strongly contrasting portions (R. D. M. Verbeek, 24, p. 797), one with an exceptionally uniform and undisturbed submarine topography, and another with an extremely complicated structure.

Great as is the contrast between those two areas with regard to their present physical features, no less is this the case with regard to their geological history, as I have shown elsewhere (Bibl. 11, p. 232). The area to which the shelf seas belong, at least since the close of the Pliocene Age, has been stable, and thus has not been disturbed by any orogenetic movements, whereas the area to which the deep-sea basins belong since that time has continued to be unstable and orogenetically very active.

The Shelf Seas and the former Sunda Land.—The almost perfect uniformity in depth of those shelf seas suggests that they are originated by changes of the sea-level rather than by diastrophism. In the year 1916 (Bibl. 13, p. 612) while discussing Daly's glacial-control theory (Bibl. 7) and again in the year 1919 (Bibl. 14, p. 404) the author has given his ideas on the causal relation between the origin of those shelf seas and the Pleistocene glaciation, which will be referred to shortly here, as far as the Sunda shelf is concerned. At the end of the Pliocene period or at the beginning of the Pleistocene Age the present Sunda sea probably consisted of low land or a group of islands. One might imagine an imperfect

peneplain partly covered by the sea. At the beginning of the Ice Age the sea-level sank in consequence of the growth of the Pleistocene icecaps (see Penck, Bibl. 19 and 20; Daly, Bibl. 6 and 7) and stood at least 40 fathoms lower than at the present day. A great area was laid dry and united the present islands of Sumatra, Borneo, and Java. This land is called the Sunda land. This Sunda land probably has existed as a stable continental landmass at least since the beginning of the Neogene Age.

During the Pleistocene Age a period of long-continued erosion followed. This process was active, the erosive power of all the streams and rivers having been intensified by the lowering of their base-level. Then an extensive gradation-plane was formed, from which only here and there exceptionally resisting portions protruded as groups of rounded hills or monadnocks. The broad peneplain was bordered to the west, south-west, and south by the partly volcanic, partly non-volcanic high mountains of Sumatra and Java; towards the north, north-east, and east by the huge granite bosses, the high sandstone plateaus, and the older mountain chains of Borneo. In this peneplain the rivers which flowed from the mountains united into two or more powerful streams, which discharged probably into the South China Sea and into the southern shallower portion of the strait of Makassar.

At the end of the glacial period the sea-level rose again to its present height consequent on the melting of the ice-caps. The Sunda peneplain was gradually submerged and for its greater part converted into a shelf sea, the great Sunda-shelf sea. The monadnocks, few in number, were isolated by the rising sea and now form groups of rocks and islands, emerging from the shelf sea, as for example Bangka, Billiton, Singkep, the islands of the Riow archipelago, the Karimata islands, the Karimon Java islands, and others.

This is of course a much simplified conception of what has happened in reality. The Ice Age has not been one single cold period, but a succession of colder glacial periods alternating with milder interglacial periods. Consequently the ice-caps more than once have grown to a large extent and have melted again. Thus we may surmise that during the first glacial period the Sunda peneplain, which probably already pre-existed in an imperfect state, has recommenced to develop; that it has been covered by the sea during the first interglacial period; that during the second glacial time it was rendered more perfect; that it was flooded again during the second interglacial time, and so on, until the last glacial period saw the peneplain in such a state of perfection, as is now illustrated by the floor of the Sunda-shelf sea.

If this theory holds good one must expect to find evidences of recent subsidence all along the coast of the Sunda sea. This is indeed the case. First of all, the land up to a great distance from the coast is flat and no traces of upheaved modern coastal formations of any importance are

known. The even surface of the shelf is prolonged without altering its character far into the interior in the low peneplainized country surrounding the major portion of the Sunda sea. Along the western coast of Borneo a retreat of the sea to a depth of 10 fathoms would connect no less than eighty smaller and larger islands * with the main land, and their higher portions with their smooth contours would be incorporated into the still

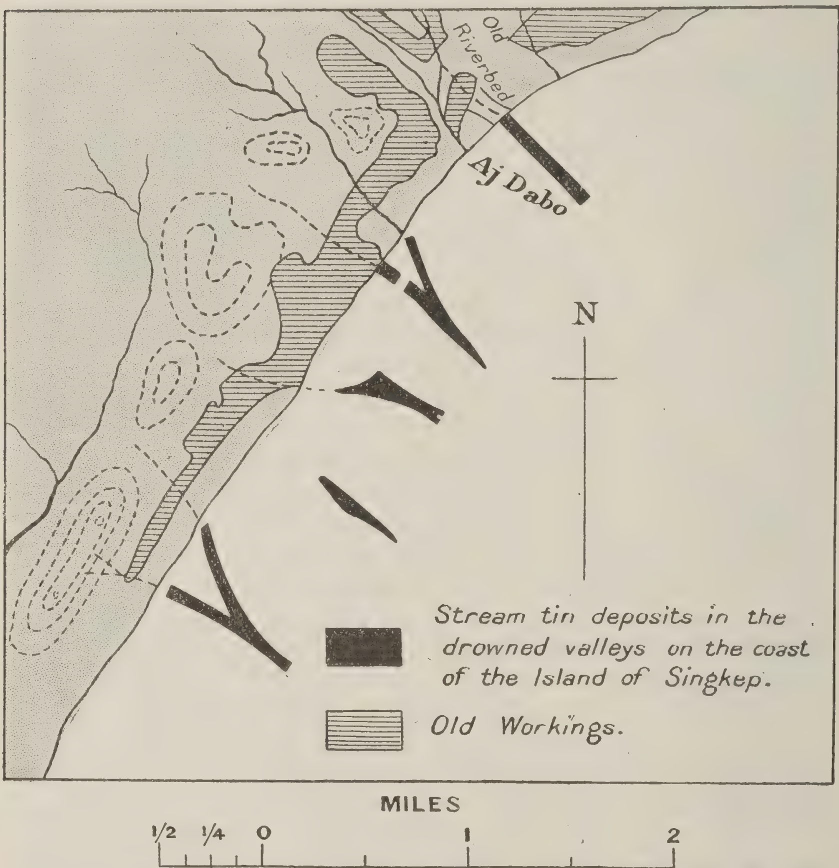


Fig. 1.—Stream tin in drowned valleys off island of Singkep, Sunda Sea, east coast of Sumatra, south of Singapore

unflooded portion of the extensive peneplain of West Borneo without the scenery of the landscape being altered in any perceptible degree.

Further, deltas are generally wanting, although the rivers both of Borneo and Sumatra transport heavy loads of sediment towards the sea; only two of them, the Pawan and the Kapuas, have built out a delta which, however, even in the case of the Kapuas, which carries more sediment than any of the other rivers, hardly protrudes from the coast-line into the

* Not including low alluvial islands, exclusively composed of modern detritus.

sea. In general the coast-lines are embayed, and the rivers possess wide funnel-shaped mouths with great depths in their lower courses. The submarine continuations of these rivers, *i.e.* their drowned portions, can

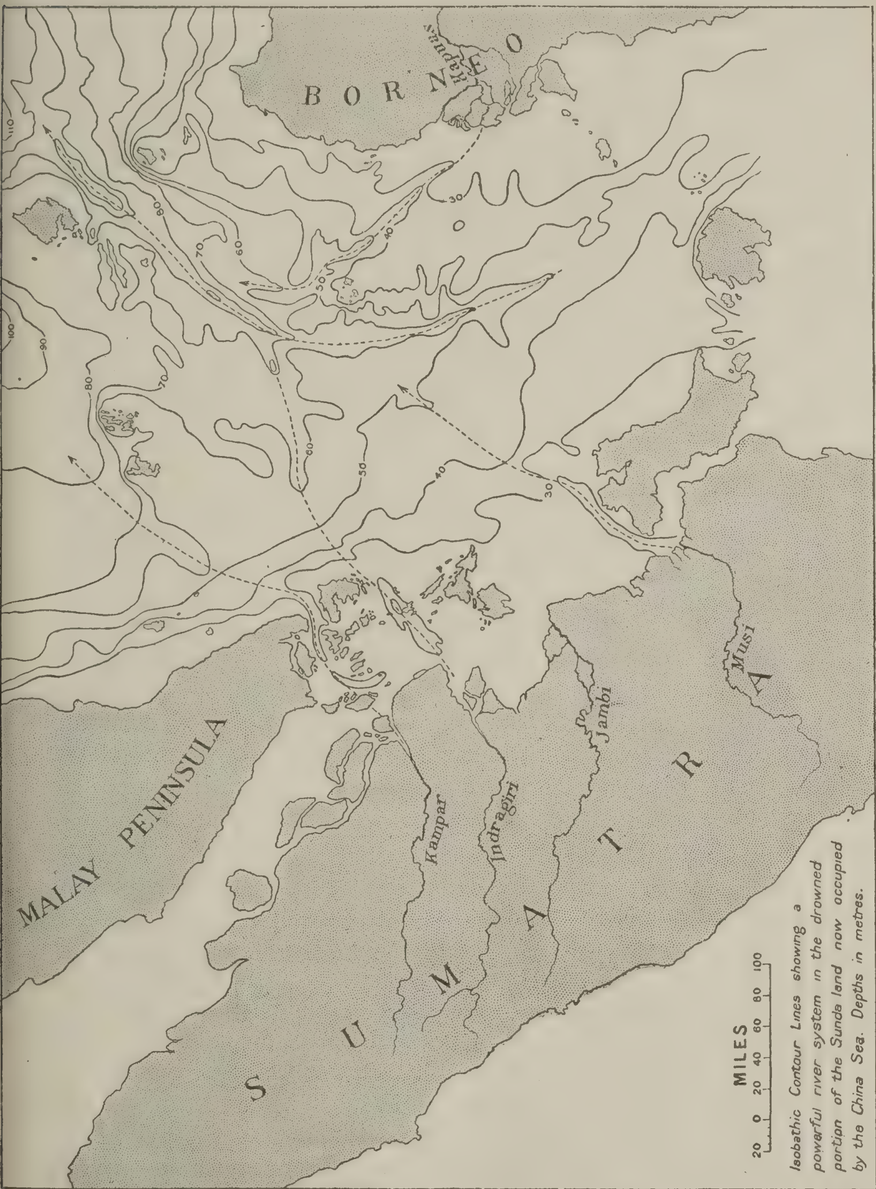


FIG. 2.—ANCIENT RIVER-SYSTEM OF THE DROWNED SUNDA LAND

[*From the map compiled by Commander H. M. van Weel*

be traced in many instances. Thus the submarine course of the Sampit river can be traced to a distance of 35 kilometres from the coast as a shallow gully in the shelf. On the island of Singkep the tin ore deposited

in the lowermost strata of the alluvium in the river-beds has been followed as far as 1300 metres out from the coast, lying at a depth of 9½ fathoms (17 metres) below sea-level. The exploitation of this so-called sea-tin on the south-eastern coast of this island has revealed the existence of several drowned river-beds in the shelf sea (Fig. 1).

Indeed, portions of some of the former powerful river systems formerly draining the now partially drowned Sunda land by the aid of the isobathic curves of the present Sunda-shelf sea can be reconstructed with a tolerable degree of accuracy. In Pleistocene time a main divide stretching across the Sunda sea from Sumatra over the islands of Bangka, Billiton, and the Karimata group towards Borneo probably separated the watersheds of at least two main streams, one draining the northern portion of the Sunda land and discharging into the South China Sea, the other draining the southern portion and discharging into the southernmost section of the strait of Makassar.

The northern main stream of the Pleistocene Sunda land is as a gully in the shelf beautifully shown on a bathymetric map of the South China Sea (Fig. 2), recently compiled by the commander of the *Brak*, H. M. van Weel.

The various rivers of Sumatra and Borneo discharging now into the Sunda-shelf sea are the dismembered side branches of these large main streams. Thus the Musi, one of the largest rivers of Sumatra, and the Kapuas, the largest river of West Borneo, both were confluents of the northern main stream, and consequently belonged to the same river system.

This hypothesis, according to Weber (Bibl. 14, p. 428), affords explanation of some remarkable facts in the geographical distribution of the freshwater fishes of Australasia. The fish fauna of the Musi and other big rivers of the east coast of Sumatra has a striking similarity to that of the Kapuas on the island of Borneo, although both river systems are now separated by a wide expanse of sea-water. On the contrary, the fish faunæ of the Kapuas of the west coast of Borneo and the Mahakkam or Kutei of the east coast of Borneo show great differences, notwithstanding the fact that both these rivers spring from the same divide. From a total of 142 species known, only 52 are common to both these rivers, the majority of these being found also in other parts of the Sunda islands. From the remaining 90 species 23 are found in the Mahakkam and 67 in the Kapuas. No less than 52 or 75 per cent. out of the latter 67 species are known to occur in the rivers of east Sumatra as well, whereas only 12 species are restricted to the Kapuas. No less than 17 or 74 per cent. out of the 23 species which occur in the Mahakkam, but do not live in the Kapuas, are restricted to the Mahakkam and some neighbouring rivers. Three species out of these 23 only are known to occur in the Mahakkam as well as in the rivers of East Sumatra. Thus the Kapuas owes its superiority in number of its fish fauna as compared with that of the Mahakkam, not to its autochthonic species, but to those species which it

has in common with the rivers of East Sumatra. These facts tend to make probable a former connection between the river system of the Kapuas and the rivers of East Sumatra, which according to the hypothesis explained above must have existed in Pleistocene time before the gradual submerging of the Sunda land.

Finally, a direct proof of the said immersion is given by the magnificent barrier reef which marks the position of the east coast of the submerged Sunda land. This reef, which appropriately may be named the Great Sunda barrier reef (Fig. 3), extends roughly parallel to the south-eastern coast of Borneo, from the Ambungi coral island 120 kilometres south of the mouth of the Kutei or Mahakkam river to a point in 5° 40′ South lat. over a length of about 500 kilometres. From Ambungi island it first runs in a south-easterly direction to a point just opposite cape Ongkona on the island of Celebes. From here it turns sharp into a south-westerly and further into a south-south-westerly direction. At the bend opposite cape Ongkona it is 230 kilometres distant from the nearest point of the coast of Borneo, and only 44 kilometres from the coast of Celebes. In a westward direction towards Borneo the depth of the lagoon is very uniform, in the average about 45 metres and nowhere more than 75 metres; eastward of the reef towards the island of Celebes the depth of the sea increases abruptly to 200, from there rapidly to 1000, and thence in a small distance to 2385 metres. The barrier reef is interrupted at many places, and its separate coral islands only here and there reach the surface of the sea. A well-marked row of coral islands, the so-called Laurel reefs, constitutes the southern portion of this long barrier reef.

As stated above, the barrier reef ends at about 5° 40′ S.; then follows a gap of 100 kilometres in width facing a deep embayment of the former Sunda land, into which most probably one of the main watercourses draining that country discharged and deposited a portion of its sediments. More to the south the barrier reef reappears in the Kwong–Eng reef, and can be followed from there as far as the Kangeang islands.

This great barrier reef evidently originated from a fringing reef which in late Pleistocene time extended along the east coast of Sunda land. With the gradual rise of the sea-level after the close of the glacial period and the gradual immersion of the Sunda land the reef has grown up and in many places succeeded in maintaining its position at or near the sea-level. This barrier reef until lately (J. F. Niermeyer, Bibl. 18, p. 884 and Map. xiii. 2) has not been recognized as such, mainly on account of insufficient knowledge of the depths of the sea in the strait of Makassar, and also on account of its exceptionally great distance from the coast to which it belongs. The large atolls in the southernmost portion of the strait of Makassar are probably originated by the submersion of islands belonging to the Sunda land (Bibl. 14, p. 421).

On the northern coast of the former Sunda land no barrier reef in the present South China Sea is found indicating the position of the

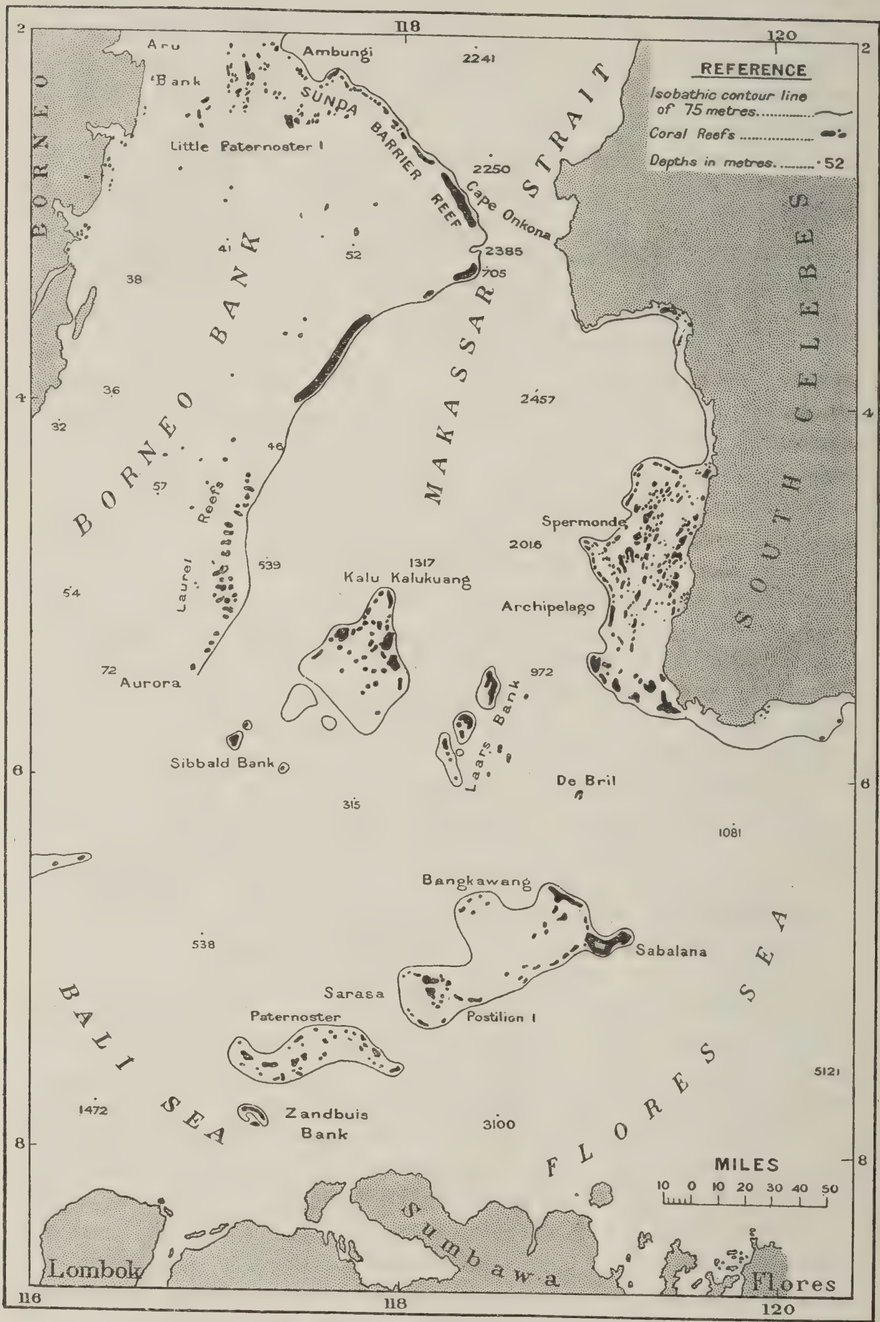


FIG. 3.—THE GREAT SUNDA BARRIER REEF AND ATOLLS

Pleistocene coast-line. A plausible explanation of this fact is that in Pleistocene time, as is revealed by the present isobathic curves, the land on this coast was very flat and merged gradually into an extensive shelf, which, consisting of loose sand and muddy sediments, probably did not offer favourable conditions for the development of fringing reefs.

The Sahul Shelf.—The Sahul shelf has much the same geological history as the Sunda shelf. In late Pleistocene time the mainland of Australia was connected with New Guinea and the Aru islands by a flat land, probably a peneplain. After the close of the glacial period this low-lying country was flooded by the general rise of the sea-level, and has been converted into the present Sahul shelf.

I have not been able to collect sufficient data to unravel the geological history of this shelf in detail. I shall confine myself, therefore, to this remark, that at many places the position of the Pleistocene coast-line appears to be indicated by coral islands, and that the present shore-line of north-west Australia, as well as that of the south coast of the western portion of New Guinea, is deeply indented. The fiord-like lower course of the Prince Regent River (J. W. Gregory, Bibl. 9, p. 348) presents a typical example of a submerged or drowned valley.

The Deep-Sea Basins and their Surroundings.—The geological history of that portion of the East Indian archipelago to which the remarkable deep-sea basins are confined is quite different from that of the stable portion which has just been dealt with. Although the topography both of the land and the sea-bottom is very complicated, a few main features stand out well, and cannot fail to attract attention. These features are the well-marked trough-shape of the majority of the deep-sea basins, the elongated form of nearly all the islands bordering on these basins, their elongation being in the same direction as that of the troughs; the arrangement of both the basins and the islands in curved rows; and the conspicuous signs of elevation in modern times exhibited by those islands.

It is reasonable to surmise that a genetic connection must exist between the subsidence of the trough-shaped deep-sea basins and the elevation of the adjoining elongated islands; indeed, the common origin of these antagonistic movements, according to my opinion, has to be sought in one and the same crustal movement, viz. in a process of folding at a certain depth. If the question were raised as to what might be seen at the Earth's surface if an area were folded by crustal movement at a certain depth, I should be inclined to reply that its appearance would be similar to what obtains at present in the eastern portion of the Indian archipelago (Bibl. 11, p. 231).

Near the surface alternating zones of subsidence and of elevation are found, and the ranges of trough-shaped deep-sea basins mark the position of the synclinal axes, whereas the ranges of elevated islands mark the position of the anticlinal axes of the major folds, which are in process of formation at a certain depth. Deep-sea research has proved that these islands, for

example, those of the non-volcanic range encircling the central Banda sea, stand on a well-marked continuous submarine ridge with a fairly uniform depth of 800–1500 metres, and that they are generally separated from each other by deep channels often of considerable width. These facts ask for explanation.

As soon as the upper portions of the folds which develop at a certain depth approach the Earth's surface and the majority of the rocks under diminished pressure can no more be folded without being fractured (*van Hise's* zone of fracture), the continuity of the strata will be broken and the culminating portions of the elevating anticlinal axes will be fractured and show at the surface as isolated portions or blocks, their extent and shape being greatly dependent on the geological structure and the differences in rigidity of the composing rocks. This may suffice to explain why an elevating submarine ridge formed by an anticlinal axis will appear at the surface as a row of blocks, *i.e.* islands separated by deep channels.

But this alone would not yet explain the great width of many of the straits between the islands. Here another factor still may play a rôle (H. A. Brouwer, Bibl. 5). It is an established fact that arcuate anticlinal ridges during their devolopment generally shift their axes in an outward direction, and thus progressively cover more and more ground. The tension resulting from this movement will not interfere with the continuity of the ridge at a certain depth where plastic deformation of the rocks can take place, but near the surface will break up the upper portion of the anticlinal ridge into blocks of different sizes which will be separated by gaps. These blocks may moreover shift their position with regard to each other over more or less considerable distances. Thus a somewhat irregular curved row of islands, resembling the ranges encircling the central portion of the Banda sea, may be formed, the islands being separated one from the other by gaps of varying and often great depths.

In the great geosynclinal area between the continents of Asia and Australia one arc of folding belonging to the Alpine system, and known as the Malay arc, appears to originate from the Burma arc, the south-easternmost range of the Eastern Himalayan system, and can be followed through the domain of the East Indian archipelago from the extreme north-western end of Sumatra, through this island and the island of Java, and from there in a double row of islands as far as the Banda sea.

In its western section where it borders on the Indian Ocean, as in the central portion of the island of Sumatra, this arc now consists of two major folds, as is illustrated by an ideal cross-section (Fig. 4) * from the Indian Ocean towards the stable portion of the Sunda land. It would show the following sequence :

* Verbeek has first recognized that these major folds, which date from pre-Tertiary time in their successive phases of development, always have determined the principal features of the geological structure of Sumatra. Bibl. 23, pp. 543–550, and figs. 50–55.

1. Indian Ocean.

2. Sunda trough, first geosyncline.

3. Range of coastal islands girdling the west coast of Sumatra including the Mentawei islands, first geoanticline.

4. Mentawei trough and corresponding trough-shaped depths, second geosyncline.

5. Non-volcanic and volcanic mountain ranges of Sumatra and Java, second geoanticline.

6. Tertiary terrain, folded in late Tertiary and early Pleistocene time, now practically stable, third geosyncline.

7. Stable Sunda land, including the Sunda shelf.

In this western portion the position of the following deep-sea basins is determined by the present phase of the process of folding:

1. The Andaman basin.

2. The Mentawei trough.

3. The Sunda trough.

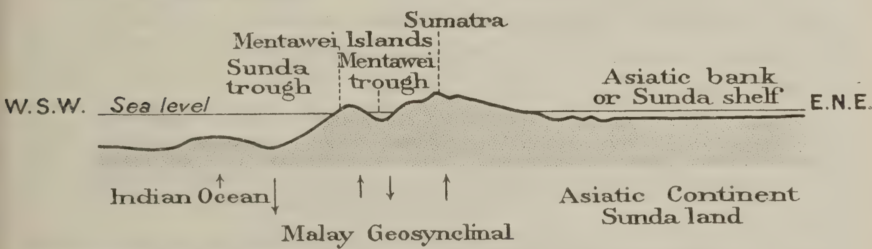


Fig. 4.—Schematic representation of late Tertiary Pleistocene and post-Pleistocene crustal movements in the western section of the Malay or Australasian geosynclinal area

In the south-eastern section of the same arc the process of folding has been modified by the proximity of the stable Australian continent and the thrusting against its edge.

In its easternmost section in the Moluccas the crustal warping is of an extremely complicated nature on account of the fact that two great orogenetic systems, the Alpine system and the circum-Pacific system,* here meet and are interlaced. The Malay arc belonging to the Alpine folding system in the Moluccas is represented by two more or less parallel curved rows of islands, the inner being volcanic, the outer non-volcanic. After having curved round the Banda sea, it is completely rolled on itself and disappears in the Banda basin (H. A. Brouwer, Bibl. 3). The last island of the non-volcanic row appears to be the island of Buru, and the volcanic row appears to end in the Banda group or possibly beyond the shoals of the Lucipara group in the Gunung Api.†

* This is the current opinion endorsed by E. Haug and P. Sarasin. It remains, however, open to discussion whether it would not be more recommendable to distinguish between a circum-Asiatic system and an Australo-Pacific system.

† There is some reason to surmise that the Ceram-Buru arc being broken off west of Buru might have its continuation through the Tukang Besi islands, and from these through Buton and the portion of Celebes east of the Boni-Posso depression.

The major folds of the Malay arc in its eastern section determine the position of the following sea basins and ranges of elevated islands.

I. Australian continent and Sahul shelf.

II. Folds of the Malay arc.

1. Timor trough, Kei trough, Ceram-Aru trough, Ceram sea, first geosyncline.
2. Row of fifteen larger and numerous smaller non-volcanic islands ranging from Sumba over Timor to Buru, first geoanticline. This curved row, after its most important constituents, is also known as the Timor-Ceram row, or the Timor-Ceram arc.
3. Savu sea, Wetter trough, East Banda trough including the Weber deep, second geosyncline.
4. Row of eight larger and numerous smaller volcanic islands and rocks, ranging from Bali over Alor and Wetter to the Banda group, possibly to the Lucipara shoals and Gunung Api, second geoanticline.
5. Flores sea and the central Banda sea, third geosyncline.

These relations are illustrated in an ideal section (Fig. 5). More to

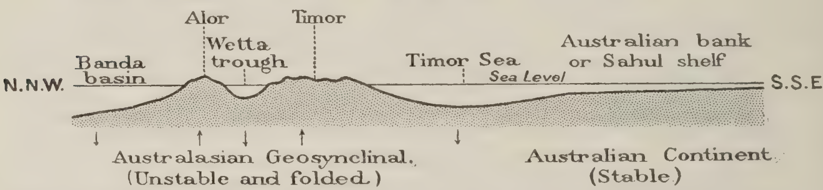


Fig. 5.—Schematic representation of Pleistocene and post-Pleistocene crustal movement in the eastern section of the Australasian or Malay geosynclinal

the north the position of the majority of the deep-sea basins of the East Indian archipelago has been determined by the major folds in the geosynclinal area bordering on the east coast of Asia and belonging to the circum-Pacific system. It appears that the remarkable basins of the Sulu sea and the Celebes sea, including the Strait of Makassar, are modified troughs lying between anticlinal axes fanning out from the Philippine islands towards the south (W. D. Smith, Bibl. 21).

The tectonics of North Borneo, the Philippines, and New Guinea are however, as yet little known, and it would be hazardous to enunciate speculative ideas on the relations between the deep-sea basins of the northern and north-eastern portion of the East Indian archipelago and the marginal folding in the Pacific Ocean along the coast of the Australian continent and of New Guinea.

Distribution of Coral Reefs.—The distribution of coral reefs and coral islands in the unstable or geosynclinal portion of the East Indian archipelago is well in harmony with the theory the brief outlines of which are given above, according to which both the deep-sea troughs and the ranges of islands separating them are in their present shape the result of one and

the same process of folding in the earth's crust in Pleistocene and post-Pleistocene time, which most probably still continues.

The first conspicuous fact is, that the islands in this region of complicated topography which in general mark the position of the main anticlinal axes almost without exception are fringed by reefs and possess a terraced appearance caused by extinct coral reefs being elevated to various heights. To quote an instance, in the interior of the island of Timor coral reefs of Pleistocene age are found elevated to a height of nearly 1300 metres above sea-level. Kisser with its terraces is one of the finest specimens of a terraced island. On several other islands the number of the elevated terraces is higher still, viz. thirteen on Kambing, fifteen on Dai, and sixteen on Dawara, according to Verbeek. The process of elevation is most probably still going on. This is exactly what the theory requires. Another not less conspicuous fact, that the trough-shaped deep-sea basins separating the ranges of elevated islands one from the other are, taken as a whole, free of barrier reefs and atolls, asks for a special explanation.

Undoubtedly the fact that these basins, marking the position of the synclinal axes, and thus indicating areas of subsidence, do not possess reef types which are characteristic of such areas appears to be in contradiction with the theory advocated above. If, however, one bears in mind that more than anything else the latest crustal warping has resulted in the emerging of ranges of islands from the sea in the anticlinal areas and in the deepening of pre-existing shallow seas in the synclinal areas, a plausible explanation can be given.

Before the latest still continuing phase of the orogenetic movements set in, the general topography of the eastern portion of the archipelago as a result of an anterior folding of probably late Miocene age resembled the present one, with this material difference, that the sea-basins were much shallower than they are to-day, and that the islands were lower and smaller. In fact many of the latter were entirely submerged and did not yet exist as such. The Pleistocene and post-Pleistocene folds described here are probably engrafted upon the older Tertiary folds.

During the process of emersion the islands continually grew larger and finally attained their present size. Fringing reefs were continually formed along the coasts during this period of upheaval, and began to be elevated as soon as they had been formed. Where they have not been destroyed later by erosion they now form part of the elevated terraces. The islands thus growing at the cost of the sea-basins, there was practically no chance for any of the fringing reefs to become converted into a barrier reef.

In this line of reasoning one has, of course, to take for granted that the pre-existing former shallower seas were free from islands and shoals. A strict proof of the accuracy of this postulate cannot be given as yet.

Fig. 6 is meant to illustrate schematically a possible mode of origin of the islands of the Moluccas with their elevated reefs, and of the deep-sea basins separating them which are devoid of barrier reefs and atolls.

Another alternative appears to be admissible. The pre-existing shallower seas may have possessed fringed islands or coral shoals, but these may have been drowned now. The downward movement caused by diastrophism in this case must have been so rapid that it could no more be compensated by the upward growth of the reef-building corals. A remarkable dredging carried out by the *Siboga* on 1 September 1900 in the deeper portion of the Ceram sea appears to give an instance. From a depth ranging from 1633 to 1304 metres over a distance of no less than 3 nautical miles large quantities of recent reef-building coral were then dredged, which had died off, and by a thick cover of manganese revealed their long stay in the sea-water after their dying off. The nearest point in these regions where living reef-building corals occur near the surface lies at 42 kilometres from the point where the dredging took place, so that those corals in the deep sea could not originate there. In order to explain the result of this dredging, I should rather suppose that on that spot in the

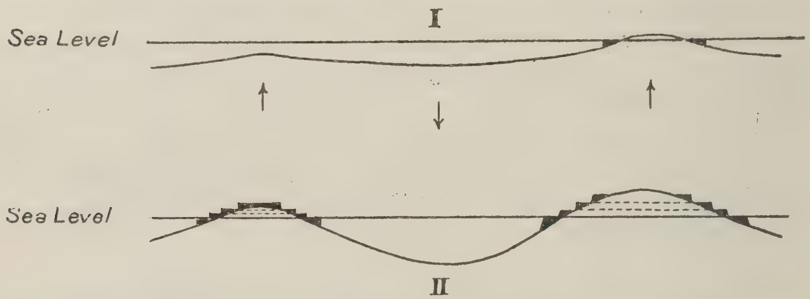


Fig. 6.—Ideal cross-sections illustrating the mode of origin of the deep-sea basins and the elevated terraced islands of the Moluccas by recent deep-seated folding. I. Before the folding. II. After the folding. Coral reefs : Black

Ceram sea from the sea-bottom, which lies at a depth of about 1600 metres, a drowned coral island rises to about 1300 metres below sea-level.

Accepting this alternative, one is led to surmise that one of the reasons why the present deep-sea basins of the East Indian archipelago, although formed by subsidence, are free from reef structures of the types of barrier reefs and atolls, is that these reefs have been drowned. Detailed deep-sea research may throw in future more light on this subject.

Some exceptions, however, are known to exist within the area concerned. A few barrier reefs and atolls are found in the basins of the unstable portion of the East Indian archipelago, as well as along the south-western coast of Sumatra, as in the archipelago of the Moluccas. I will quote a few instances from the latter region only. The group of islands south-east of Celebes, known as the Tukang Besi islands (Fig. 7), consists of four rows of islands, trending about from north-west to south-east. Two of these ranges consist of upheaved islands terraced by elevated reefs and girdled by well-developed fringing reefs ; the two remaining ranges which alternate with the former consist of small rock groups without traces of

elevated reefs encircled by barrier reefs, and of atolls or atolliform coral islands (Bibl. 10).

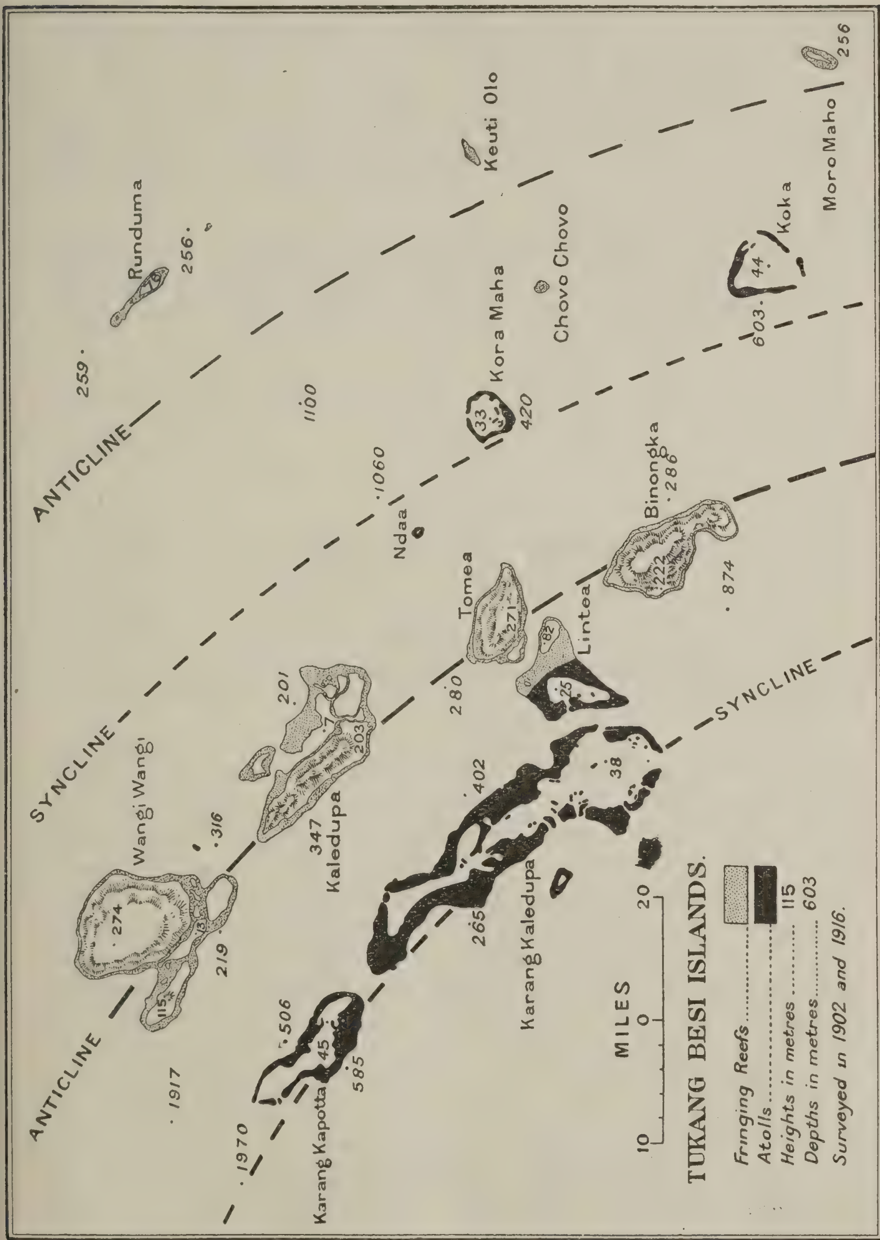


FIG. 7.—FRINGING REEFS ON THE ANTICLINES AND ATOLLS ON THE SYNCLINES, TUKANG BESI ISLANDS

Evidently in this case the terraced islands mark the anticlinal axes and the reef-encircled islands and atolls the synclinal axes of an area of active

folding at a certain depth. Some other instances are equally interesting, because they show how the development of the reefs on and along the anticlinal axes partakes of all the modifications in shape these axes undergo during their mode of formation. Consequently as a rule the upward movement of the island will not be uniform, neither will one island be elevated exactly as much as another, nor will the elevation be the same all over one and the same island. On the contrary, one must expect to find differential movements, just as well on comparing one island with another as on comparing different portions of one and the same island with each other.

First of all, the anticlinal axis may in its line of trend develop culminations and depressions (cp. H. A. Brouwer, Bibl. 4, p. 820), and thus show a more or less important pitch. Barrier-reefs and atolls may develop where

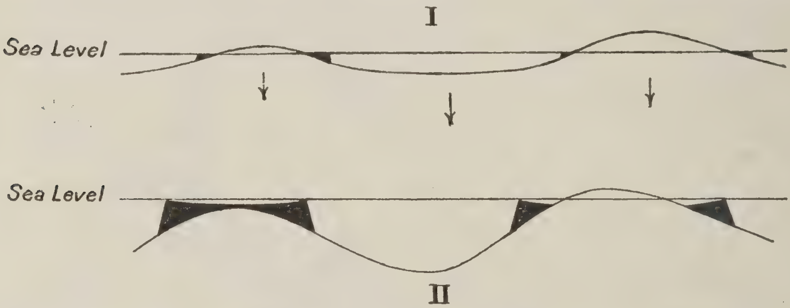


Fig. 8.—Ideal cross-sections illustrating the mode of origin of barrier reefs and atolls in anticlinal areas by folding and pitching of the anticlinal axis. I. Before the folding. II. After the folding. Coral reefs: Black

such depressions occur (Fig. 8). The axis of the Timor-Ceram (Sumba-Buru) anticline shows a well-marked depression in the group of the Sermata islands. In this group, encircling Luang and the Ukenas islands, beautiful barrier reefs are found. The pitch of the axis of the Timor-Ceram (Sumba-Buru) anticline, both from the west and from the east towards the island of Luang, can be calculated from the position of the uppermost elevated modern reefs in the adjoining islands of the range. Going from west to east these elevated reefs are found at the following altitudes:

Central Timor		1300	metres
East Timor	estimated	600	,,
Letti		140	,,
Lakor		20	,,
Luang and Ukenas islands: no elevated reefs, no fringing reefs			
Sermata	submersion	400	,,
Babber	,,	650	,,

Sometimes a submarine anticlinal axis pitching downwards can be followed by the position of coral islands which have grown up from its

submerged portion. Thus probably the Lucipara coral shoal marks the continuation of the submerged volcanic range of islands, Wetter-Banda, in the central Banda sea.

Secondly, the bend of the anticlinal axis may be accentuated during the process of upheaval, which in a normal case of folding will often occur. The uprise in such a case is no more uniform, and the elevated reefs are no longer found in a horizontal position, but more or less sloping. The island of Timor furnishes a good example, as I have shown (Bibl. 11, p. 228, and 12, pp. 693–696). The coral reefs are differentially elevated on this island; reefs of one and the same age, which in places are still coherent along the central axis of the island, are much more elevated than those nearer to the north and south coasts.

In fact, the reefs of the Dirun ridge south of the Lakaän near the central axis of the island occur now at an altitude of 1283 metres, about 680 metres higher than those on the hills of the north coast at Balbo. The big reef also of the Gempol cliff in the central portion of the island not far from Kapan has an altitude of 1250 metres above sea-level, whereas in the southern mountain ranges near Niki-Niki the highest altitude at which coral reefs are found is only 750 metres. The elevation of the central portion of the island has been from the beginning somewhat stronger than that of the southern and northern coastal regions, the entire island thus forming the feebly curved arc of a large anticline.

Furthermore, the axis of the developing anticline can shift its position (H. A. Brouwer, Bibl. 4, p. 822), which will cause tilting and unsymmetrical

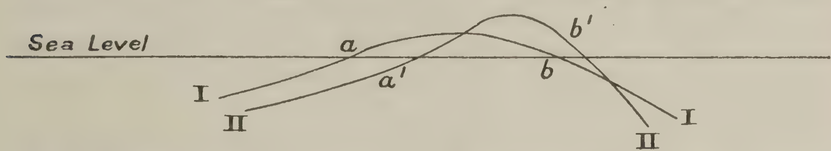


Fig. 9—Successive stages of development of an island situated on an anticlinal axis. Fringing reef formed at *a* and *b* during Stage I. would be found at *a'* and *b'* in a later Stage II. The fringing reef at *a* (Stage I.) would have been submerged and a barrier-reef have developed at *a'* (Stage II.), whereas the fringing reef at *b* (Stage I.) would have been elevated and been found at *b'* (Stage II.).

development of the elevated reefs. Such a shift of the axis can coincide with alterations in the dip of the sides of the anticline (Fig. 9), and the result can be the development of a barrier reef at one coast of an island, whereas at the opposite coast simultaneously fringing reefs are elevated above sea-level. Thus in this case simultaneously on the coasts of one and the same island fringing and elevated reefs as well as barrier reefs can be developed. On the islands of Roti and Sumba the reef terraces are distinctly tilted and unsymmetrical. The island of Jamdena offers a good example of subsidence at one coast, the northern coast, and upheaval at the opposite coast.

Finally, it may be pointed out that on studying the occurrence and the distribution of coral reefs in the unstable or orogenetically active portion

of the East Indian archipelago, one must not lose sight of the fact that the oscillations of the sea-level in connection with the Ice Age have taken place here just as well as in the stable Sunda land. These oscillations may probably give an explanation of the origin of some of the barrier reefs which occur along the coasts of some of the islands adjoining deep-sea basins, as has been shown by Niermeyer (Bibl. 18). Only the effect of these oscillations has been modified or totally overwhelmed here by that of the orogenetic forces, whereas in the stable Sunda land it is shown as such and unmodified.

To sum up, the latest researches on the geological history of the deep-sea basins of the East Indian archipelago and of the islands connected with them, have led to the following conclusions and suppositions:

1. The Australasian Mediterranean Sea consists of two strongly contrasting areas, one with an exceptionally uniform and undisturbed submarine topography, and another with an extremely complicated structure.

2. The first area is that of the great shelves, which are attached to the continents of Asia and Australia; the other that of the enclosed deep-sea basins.

3. The area of the shelf seas has been stable and has not been affected by diastrophism, at least since the end of the Pliocene Age. The area to which the deep-sea basins belong has since that time continued to be unstable as it was before, and has been, and is still, the seat of powerful orogenetic movements.

4. The shelf seas owe their origin to the submersion of a strongly peneplainized land surface caused by a rise of the sea-level of at least 40 fathoms, consequent on the melting of the ice-caps at and after the close of the Pleistocene Ice Age.

5. The deep-sea basins and the adjoining elevated islands are simultaneously formed, and continue to be developed by a process of folding at a certain depth.

6. The islands are elevated and grouped in rows because they are nothing but the culminating and fractured portions of submarine ridges which rise up on top of the anticlinal portions of the deep-seated folds. The trend of each row of islands roughly indicates the line of strike of the anticlinal axis of each of these folds.

7. The deep-sea basins are elongated more or less exactly parallel to the adjoining rows of islands, because they are formed above the subsiding synclinal portions of the deep-seated folds.

8. All the islands are, as a rule, upheaved, but the upheaval has been very unequal, as can be observed if the islands are compared one with another, or if a comparative examination be made of different portions of one island. In exceptional cases the upheaval is wanting, and even subsidence may occur instead, as has been explained above.

9. The consecutive phases of development of the anticlinal portions of

the folds are revealed at the surface by the mode of development of the reefs, and can be studied by comparing the character and the relative position of extinct reefs of the same age,

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25. MAX WEBER. See above, No. 14.

Before the paper the PRESIDENT said: The lecturer this evening is Dr. Molengraaff, who is the head of the Geological Laboratory at the Technical Institute, Delft. He has paid three long visits to the Dutch East Indies and travelled in the interior of Borneo and Celebes, and is one of the greatest authorities on that region. We and the Dutch, for many centuries, have been rivals in the East Indies, and I understand from Dr. Molengraaff's paper that he proposes that we should be rivals for many million years yet. He is going to give us an account of how the Himalayas of the future are arising out of the Dutch East Indian archipelago. In that part of the Indies over which we hold administration there are the highest mountains in the world, but Dr. Molengraaff will tell you how perhaps still higher mountains are at this very moment emerging from out the ocean depths which may in course of time—I do not know how long—arise and rival the Himalayas. It is by great kindness on the part of Dr. Molengraaff that he is speaking to us here in England. He has taken the trouble to come over from Holland to read us this paper. He has not had much practice lately in giving public lectures in English, but I am sure you will all appreciate his consideration in speaking to us in our own language.

Dr. Molengraaff then read the paper printed above, and a discussion followed.

Dr. FRIDTJOF NANSEN: I am very unexpectedly called upon to speak to-night, and I can say only it is with the deepest interest I have listened, as I am sure we all have listened, to this most interesting lecture, and heard all these very important results that have been obtained by this hydrographical work in the East Indies. There is one part of this lecture which has appealed specially to me, as it covers much the same ground as I myself have been investigating, namely, the shelves of this Mediterranean sea of the tropics. It is one of the biggest submarine shelves in the world. There is another shelf of similar large extension, but formed in different circumstances, north of Siberia, which I had the very good fortune to investigate myself. The depths are, as far as I understand, very much the same; the configuration seems to be very similar, and the edge lies very nearly in the same depth. These are two of the greatest shelves in the world; the third is east of South America. The depth is to a great extent about 40 fathoms, or less than 100 metres. The shelf north of Siberia is something like 400 or 500 miles broad, and the sculpturing of the surface seems to be very much the same. You call it a peneplain. I think that is quite right, but it is a peneplain that at least in the north has to some great extent also been levelled by marine denudation. I don't know how far that is the case with the shelf in the south, but it is with the shelves of the Polar Sea. There the marine denudation is chiefly caused, in my opinion, by an action not possible in the tropics, namely by the frost. I think the frost on the shoreline is one of the chief reasons why the shelves on all sides of the Polar Sea are very broad—very broad north of Siberia, and I am sure we are not mistaken if we think it also very broad north of the unknown coast of the American continent.

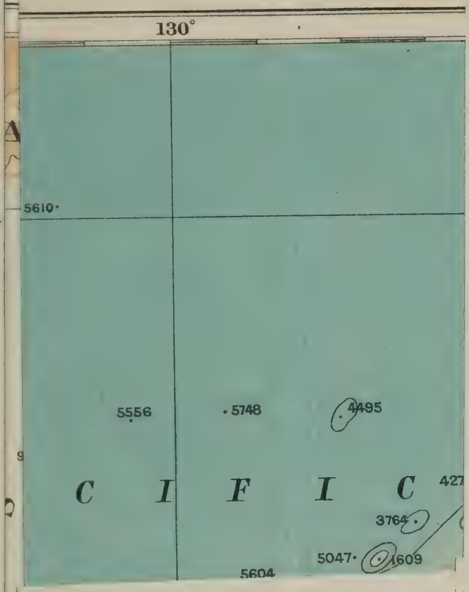
We do not know yet its extension towards the north. This frost denudation has been very violent on account of the low temperature, which has caused the water and the ice and snow on the shore to alternately melt and freeze and made the sea eat gradually on to the land. The land has been denuded by the atmospheric erosion, and more or less transformed into a peneplain that is approaching the level of the sea, but I consider it quite impossible that the peneplain could be formed so perfectly level as these drowned plains really are. I understand from the map that the surface of this East Indian shelf is perhaps not quite so level. It is, however, remarkable that under so different conditions, as in the tropical sea, where the erosion is chiefly caused by chemical action at high temperatures, and the Polar Sea, where caused chiefly by the frost and low temperature, the results should turn out to be almost the same—shelves with nearly the same level surface and same features, and they are submerged about the same depth. They seem to indicate that there must have been a general rise of the sea surface during modern geological times. The chief reason for this must be that the volume of the sea has been increased partly by the melting of the great ice-caps of the Ice Age. The sea must have risen something like 100 metres, or 50 fathoms, because all the shelves in the world are submerged about that depth, and it is a remarkable feature, wherever we go we find an indication of this same shelf. I believe that we have here still a great field for future investigation that will tell us much about the past, I mean in modern times, of the oscillations of the sea-level and the land surface, and I congratulate the Dutch Government and people on the splendid results that these Dutch investigations in the East Indies have given.

Dr. J. W. EVANS: It gives me the very greatest pleasure to welcome my old friend Prof. Molengraaff. We have followed with the keenest interest and instruction what he has had to tell us this evening. He has taken us to one of the most critical portions of the whole crust of the Earth, where those two great lines of crustal weakness—the tract surrounding the Pacific and that which extends from east to west across Europe and Asia (what he calls the Alpine tract)—meet together, and there we find action of the very greatest importance proceeding. The surface of the Earth is like an ice-floe composed of great solid blocks which are always crumbling against one another. These blocks as a whole seem almost immune from any change, but in between them are very energetic movements. It was just one of these intervening regions which Prof. Molengraaff has been telling us about to-night. To the north is one of the solid floating masses; to the south another, and between them is an area subject to great lateral pressure, resulting in a series of folds; and Prof. Molengraaff has described to us in the clearest possible manner the evidence for the existence of these folds. Apparently at present, as far as I have been able to follow the lecturer, they are of a comparatively gentle character, more in the nature of undulations; and they therefore represent a very early stage in the history of mountain building. Many myriads of years must pass before these regions can rival the Himalayas in the complexity of their structure, and much must happen before then. There will be great thrusts from one direction or the other. At present I understand there is in the area described by Prof. Molengraaff very little evidence of this. If, on the other hand, we examine the remains of the old mountain ranges, formed when these islands were subject to movements similar to those now in operation in the Malay archipelago, but far more intense, mountain ranges which have long since been worn almost flat by atmospheric agency, we find there have been gigantic thrusts from the south which have piled up masses of the Earth's crust one upon

the other. I should like to thank Prof. Molengraaff very heartily for the interesting and instructive lecture he has given us to-night, and express the hope that it will be by no means the last we shall have from him at the Royal Geographical Society.

H.E. THE NETHERLANDS MINISTER: There has been every reason for me, as the President very kindly acknowledged, not to put myself to the front, but nevertheless, on account of the pleasant moments we have passed on the water with Prof. Molengraaff, I feel the need to speak and to give vent to the feelings dominating me at this moment. The first is one of great thankfulness to this distinguished Society, and especially to the President, for the delightful hours he has allowed me to pass amongst you. In the second place, I think you will acknowledge and admit the feeling of national pride that has come over me as being the representative of the country whose son we have heard reading this paper to-night. The great eloquence, with which Prof. Molengraaff has been able to explain to his distinguished audience with such clearness this paper, fills every Dutchman, and especially, I must say, the representative of Holland, with what I hope you will call legitimate pride. But in the third place, every medal has two sides, and the dark side is the knowledge of what an utterly ignorant person I am when I heard this learned man speaking about things I did not understand until I came here to-night. I must say we diplomatists (and I hope my distinguished friend Sir Walter Townley, who is here, won't reproach me for speaking in the plural) very often move in such a small circle that when we find ourselves confronted by men of science, as I have been to-night, we feel more helpless than ever. But you have put before me the great ambition to know more of these things, and I am sure a great many amongst the audience will share the feeling. If you make up your mind to see if Prof. Molengraaff was right in everything he said and want to convince yourself with your own eyes, do not go at once to the Colonies, but make a little stay in the mother country first. There is nothing which contributes so much to bringing two people nearer to each other than personal contact, and Holland and England, the Dutch and the British people, have so many things in common, they ought to be brought into nearer contact. Let that be one of the consequences of the delightful evening we owe to the Royal Geographical Society and Prof. Molengraaff, that many of you may go, in coming years, to Holland.

Sir WALTER TOWNLEY: As the President has just said, I suppose that the honour thrust upon me as I came into this room of expressing your thanks for the great interest of the lecture we have listened to, was due to the fact that I am the Chairman of the Council of the Anglo-Batavian Society which has been recently formed, the object of which is to further good relations between the Dutch and the English. You can imagine then that when I heard in the first opening utterances of the President a sort of hint that Prof. Molengraaff was going to sow the seed of further rivalry between the two peoples, who had been rather rivals for so many years, I received a slight shock, my object being the reverse. I listened, therefore, with the greatest interest to what Dr. Molengraaff had to say, and it was with considerable relief I weighed it up, and I made up my mind that at least what was to come was not going to come for centuries. Then I saw it was the rivalry of the old traveller in India, who felt as if the great mountain he had explored and loved so well was to have some of its glories taken from it. I think he need have no fear on that score. What he has done in the Himalayas will live for a long time, but that will be forgotten by the time these other mountains have grown up. We have learned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THE EAST INDIAN ARCHIPELAGO
to illustrate the paper by Prof. G. A. F. Molengraaff.

Scale, 1/10,000,000 or 1/10 M.

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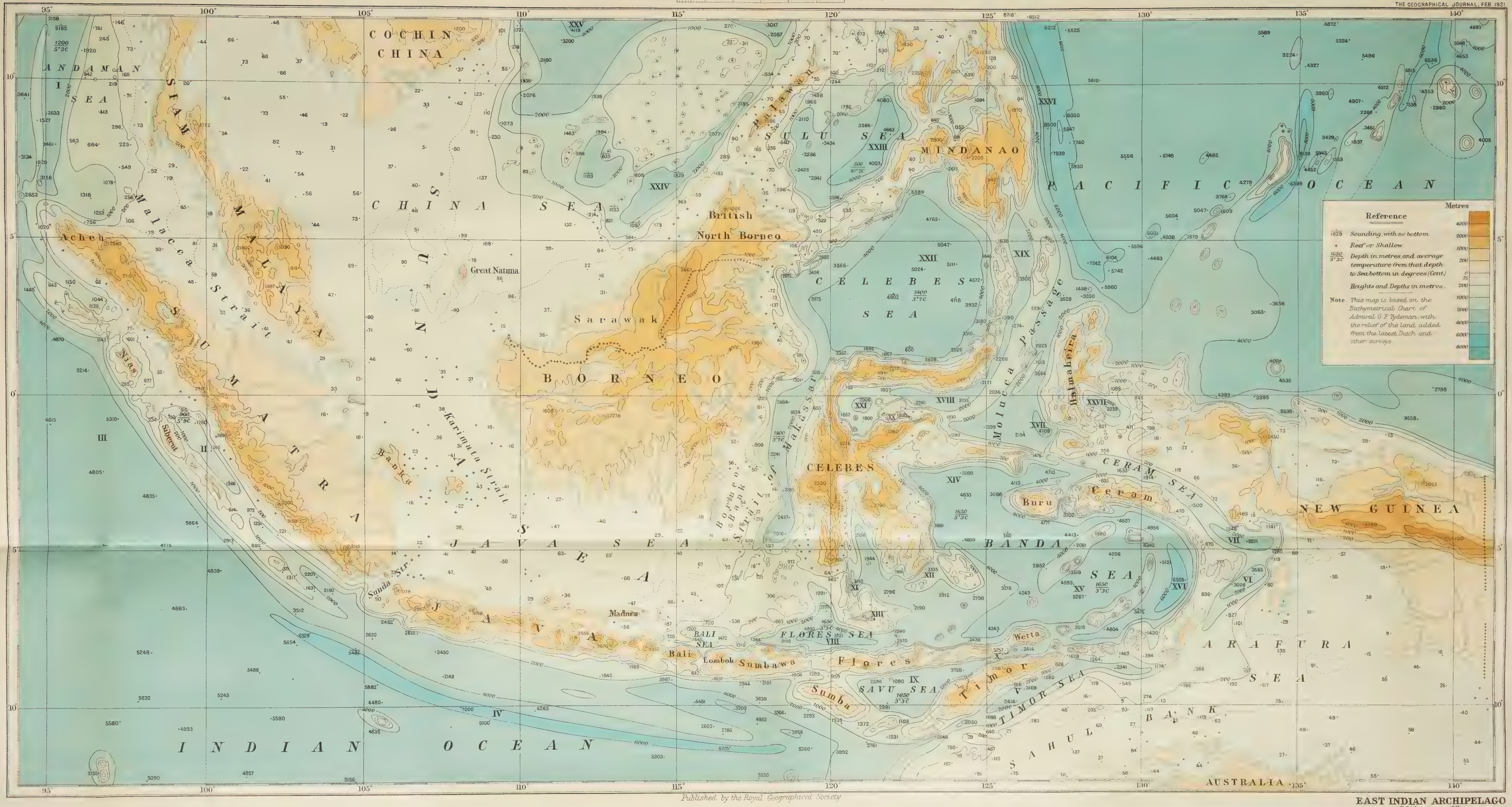
THE GEOGRAPHICAL JOURNAL, FEB. 1921



Published by the Royal Geographical Society

DEEP SEA BASINS

I. Andaman Basin
II. Mentawei Basin
III. Mentawei or Sunda Trough
IV. Java Trough
V. Timor Sea
VI. Kei Trough
VII. Ceram-Aru Trough
VIII. Flores Sea
IX. Savu Sea
X. Wetta Trough
XI. Saleyer Trough
XII. Buton Trough
XIII. Kalao Trough
XIV. North-Western Banda Sea
XV. Central Banda Sea
XVI. Eastern Banda Sea and Weber Deep
XVII. Batyan Trough
XVIII. Gorontalo Trough
XIX. Sangir Trough
XX. Togean Basin
XXI. Tomini Basin
XXII. Celebes Sea, including Strait of Makassar
XXIII. Sulu Basin
XXIV. Palawan Trough
XXV. South China Sea
XXVI. Mindanao Trough
XXVII. Halmahera Basin

EAST INDIAN ARCHIPELAGO
Molengraaff.

to-night a great deal, which has been most interesting, but I think something else also both from the paper of Dr. Molengraaff and from the speech of His Excellency the Netherlands Minister, and that is that people in Holland speak our language extremely well. Do you think there are many Englishmen who could get up and deliver a lecture like that without looking at his notes in good consecutive Dutch? There are very few. Is not that rather a good lesson for us? It has been my privilege to spend two and a half years in Holland, and nearly all the Dutch speak French, English, German and probably Italian as if these were their own languages. I should like our educational authorities to bear that in mind, and see if it is not possible to improve us a great deal in this direction. I should like to second the vote expressed by the Dutch Minister that the British and Dutch people get to know each other better. I came away from Holland with a determination that I would do what I could to further the bettering of good relations and good understanding between the Dutch and English. I do not wish to say any more except to ask you to allow me to express in your name our most grateful thanks to Dr. Molengraaff for his most admirable lecture, to which we have listened with so much interest.

The PRESIDENT: I am sure you would wish me to second what has been been said already by His Excellency the Netherlands Minister and Sir Walter Townley. We have listened to a most valuable and interesting lecture delivered in our own language with perfect fluency, and the Professor has put before us an extremely complicated subject in an exceedingly clear manner. We shall all wish to thank him for having taken the trouble to come over from Holland and for the way in which he delivered this lecture.

SOME OBSERVATIONS ON THE APPROACHES TO MOUNT EVEREST

Lieut.-Col. C. Howard Bury

DURING the summer of 1920 I was in India, on a mission from the Society, interviewing the various authorities concerned and trying to get permission for an expedition to Mount Everest. Unfortunately I was unable to get back in time to hear General Bruce's most interesting lecture on the various projected attempts to approach Mount Everest, and the discussion that took place afterwards.

As he pointed out, the chief and in fact the only obstacles that lay in the way of an approach to the mountain were political difficulties; there were questions that arose in different years between the Indian, Tibetan, Nepalese, Chinese, and Russian Governments, and these had to be settled first. At last, however, these difficulties have been smoothed away, and permission has been granted by the Indian and Tibetan Governments for an expedition to proceed to Mount Everest. There is thus every prospect that in the year 1921 the secrets that surround and veil the highest mountain in the world will be uncovered.

The mountain can be most easily approached from the northern side, and the road from Darjeeling to Phari over the Jelep La, and then viâ

Kampa Dzong and Tingri Dzong, would appear to present the fewest difficulties.

The direct road to Kampa Dzong viâ Gangtok and the Teesta valley, though it may be a day or two shorter, has many disadvantages. It is very little used by pack transport, and the path for several days follows the bed of the hot and feverish Teesta valley, where the rainfall is always heavy and where leeches abound. In places below and above Chungtang, where the path cut out of the solid rock overhangs the Teesta and Lachen rivers, there is hardly width sufficient for pack transport, and the loads would have to be taken off the mules and carried across these places. Whereas by going over the Jelep La the zone of the leeches and the heavy rainfall is soon crossed, and once in the Chumbi valley the climate is excellent, and there are no difficulties for pack transport. This is at present the main trade route into Tibet, and every day great numbers of mules and pack-ponies cross over the Jelep La, and in consequence grain and fodder can be obtained without any difficulty. From Phari to Kampa Dzong there are no obstacles; there is a regular trade route taking from three to four days and crossing over open and undulating country.

From information that I was able to obtain, the road from Kampa Dzong to Tingri Dzong presents no difficulties, and takes about seven days; from high ground north of the Naku La I could overlook several days' marches along this road, which appeared to follow along broad valleys about 15,000 feet above sea. There seemed to be no obstacles, or high passes which it would be necessary to cross.

Mount Everest I saw on several occasions in September, but always in the mornings or evenings. During the daytime heavy monsoon clouds would work up the Arun valley and into the side valleys, penetrating a certain distance into Tibet before they finally disappeared. From this it would appear that though Mount Everest lies out of reach of the main strength of the monsoon, yet clouds and snowstorms are frequent round its summit, especially in the afternoons. It lies, however, in a far better position with regard to weather than does Kangchenjunga, which seems to attract to itself all the heaviest storms.

I do not think that there are any advantages to be gained by making use of the lower Arun valley or of the Popti La and the Pangu La. Permission might be given by the Nepal Government, though they would not be enthusiastic about it. The paths through Nepal are bad and very fatiguing, and in the long run would prove to be no shorter, and would not be suited for pack transport. On the other route viâ Phari and Kampa Dzong pack transport of mules, ponies, or yaks can be used the whole way. There is a daily post to Phari, and letters only take three days from Darjeeling. There is also a telephone and telegraph line from Darjeeling to Gyantse, so that communication with the outer world can be kept up the whole time.

Aeroplanes would be of no use in Tibet, for though there would be

many places where it would be possible to land, yet owing to the density of the atmosphere at those heights being only half what it is at sea-level, it would be impossible for the present type of machine to rise again off the ground.

It would have been very interesting to have made a reconnaissance of the southern slopes of Mount Everest by flying up the Arun valley from the plains of India. This would have been probably feasible with a D.H.9a, but would have necessitated our providing at our own expense an aerodrome at the foot of the hills, the nearest permanent aerodromes being at Allahabad and Calcutta. The Air Force in India would have been very glad to help, but they have been limited in their own expenditure and would not have been able to devote any of their small budget to a side show, though they would be prepared to lend us a machine, pilot, and photographic apparatus.

The Air Force have had but little experience of flying in the hills, and the experiment would have been an interesting one for them. Where they have flown over hills, as on the North-West Frontier, they say that the air is full of bumps and air-pockets, necessitating their keeping their machines always at least 2000 feet above the level of the ground.

Beyond this reconnaissance from the south, I do not think that aeroplanes in Tibet could be of much use to the expedition: the general height of the country precluding any active co-operation on their part.

In Tibet ponies and yaks are the universal means of transport, and no one walks if he can help it, so that all the fatigues of long marches at high altitudes can be avoided by riding. The ponies are quite acclimatized to the height, and the European who comes into the country will find that after a fortnight's residence at 15,000 or 16,000 feet, he will be able to do far more and with less fatigue than when he first arrived. At greater heights than this the vitality becomes lower and sleep at night becomes more difficult, but acclimatization for Europeans is quite possible up to 16,000 feet.

Yaks will probably be the chief means of transport: they are very hardy animals, and seem to be able to live and to thrive on the scanty herbage that appears among the stones. They do not mind altitude, and though they are very slow yet they are surefooted, and it should be possible to use them for transport up to at least 20,000 feet. The snow-line on the north side of the Himalayas is often at 20,000 feet and over, and owing to the lesser denudation these northern slopes are far less steep than those on the south side, as can be seen on Pawhunri, Chomiomo, and Lhonak peaks, where in every case the south side is a series of precipices, and the north side is a comparatively gentle snow-slope. We may hope that this will also prove to be the case with Mount Everest.

The Sherpa Bhotias will probably prove to be the best coolies for high mountain work, and young men should be picked out for this particular duty. The Bhotia too from the high villages in Sikkim, such

as the Lachen villages, people who pasture their flocks at high altitudes on the Tibetan frontier, should also prove useful. They are both of a sturdy race of mountaineers, not so independent as the pure Tibetan, and should prove amenable to training. They have also the merit of being hardy and accustomed to cold and the biting winds of the country. They should be in charge of their own sirdars, and I am rather doubtful as to the advisability of having Gurkha N.C.O.'s over them. A good cook with the expedition is of great importance, as it is most necessary to keep the digestion in good order at these altitudes.

DR. KELLAS' EXPEDITION TO KAMET

IN the course of General Bruce's paper on Mount Everest, published last month, it was announced that Dr. Kellas and Major Morshead had succeeded last autumn in reaching the saddle of Kamet (at 23,500 feet), but that transport difficulties had prevented the formation of a camp at that height, or any further advance.

Dr. Kellas had planned the ascent of Kamet with special reference to the physiological effects at high altitudes and the use of oxygen. The Oxygen Research Committee and the Medical Research Committee, under the authority of the Department of Scientific and Industrial Research, undertook to supply the necessary scientific equipment, which was forwarded by the Indian Stores Department to Kathgodam. Dr. Kellas had left for India in March, and the equipment had to be got together and forwarded to him. Some unavoidable delay occurred owing to the discovery that the very light oxygen cylinders, which passed their tests when newly made, lost strength rapidly and were not safe. It was therefore necessary to send heavier cylinders. Further delay was caused in the transport to India by certain shipping restrictions in the carriage of gas cylinders and chemicals; and finally there was some unexplained delay on the Indian railways, so that the start of the expedition from Kathgodam was considerably late, and to this one must attribute any want of complete success in the investigation. The preparations of the Oxygen Research Committee were made under the disadvantage that owing to ill health Dr. Kellas had been unable to attend to them in the preceding winter, and had to leave instructions for execution after his start. The Society must gratefully acknowledge the value of the contribution to the Mount Everest problem thus made by the Committee in difficult conditions.

Dr. Kellas, who has remained in India with the intention of making another attempt on Kamet next summer, has sent us a copy of the report he has made to the Oxygen Research Committee; and in view of its immediate importance to the Mount Everest expedition, we assume his permission to print the following extracts from it:

At the end of the first week in August part of the expedition started from Kathgodam, and on August 19 joined Major Morshead at Chomoli, about 150 miles to the north. The permanent members of the expedition included Major Morshead and his transport officer, with eleven attendants—the latter being intended chiefly for survey work, and also for transport at high altitudes—and myself with two servants. There were about eighty-three coolie loads.

From Joshimath, 29 miles north of Chomoli, transport work was difficult, and repeated unvoidable delays occurred. Four bridges had been washed away in the Niti valley by floods, but the Deputy Commissioner of Garwhal, Mr. P. Mason, made such arrangements that we had only to build one bridge over the river Dhauli.

On August 29 we started from Niti, the highest village on the route (12,000 feet approx.), with about twenty-one yaks and forty coolies (each yak carrying two coolie loads), and on August 31 reached a base camp at the end of the Raikana glacier at an altitude of 15,380 feet.

Above this point the route was very rough, and all baggage had to be carried by coolies. Carriage of wood, which could be obtained about a mile below the camp, became of special importance. Even at this base camp (No. 1) want of acclimatization to altitude began to be evident in certain cases, and incidence of malaria was also troublesome.

On September 3 an advance was made along the east Kamet glacier—which was found to be quite incorrectly given on the map—and a camp formed at about 16,800 feet. This camp was on fine sandy detritus on a bank above the glacier, and was generally regarded by the coolies as the last comfortable camp. A delay occurred here due to difficulties in connection with transport of wood, and it was September 8 before Camp No. 3 was formed at 18,500 feet on rough glacial detritus above ice. This third camp was near the base of Kamet, which rose in a series of rock precipices to the north-west, forming a comparatively sharp peak. Between this peak and the ridge of east Ibi Gamin (24,170 feet), to the north-east there was a snowy saddle of altitude about 23,500 feet, which obviously indicated the route to the summit. The increase of height between this third camp and the saddle—namely, 5000 feet—consisted firstly of 2500 feet of sharp ascent, chiefly steep scree, but partly débris-covered glacier, then came 1000 feet of precipitous rock, and finally about 1700 feet of snow and ice. From the configuration of the mountain it seemed likely that the tops of these three "pitches" would necessarily represent positions for camps 4, 5, and 6. At this third camp my chief servant became so incapacitated—he had been accidentally benighted on the glacier along with Major Morshead's servant—that he had to be sent back to Niti.

On September 11 we moved up to a camp above the screes—camp No. 4—our tents being pitched at 21,000 feet (approx.). Here the transport was unsatisfactory, and we were detained about a week. At this camp it became evident that our remaining servants would be unable to go higher. Both seemed to have reached the limit of their acclimatization powers, in spite of being adequately protected, and suffered from the cold—approx. 0° Fahr. during the night—while my servant again had attacks of malaria.

On September 19 we climbed the rocks, and formed a camp on snow at approximately 22,000 feet. After a day at this camp to allow acclimatization to take place, we ascended to a little above the saddle along with three coolies from the village of Mana, starting at 9 a.m. and reaching the saddle at 3 o'clock. At 3.30 we had attained about 23,600 feet, our maximum altitude,

but the coolies declined to attempt Ibi Gamin (24,170 feet), which seemed feasible, or to ascend further on Kamet. Starting back at 3.45 p.m. (approx.) we descended rapidly, and reached our 22,000-feet camp about 5 p.m. The wind was cold, and the three coolies with us suffered more than Major Morshead or myself, and complained of headache. A considerable amount of step-cutting was necessary, which was shared.

Next morning Major Morshead unfortunately had to descend, as his period of leave had expired, taking all the coolies with him. The coolies refused to entertain the idea of moving a camp up to the saddle, alleging that the winter storm was due, and that we would be snowed up. The threatened incidence of this winter storm had been their continual complaint since reaching Camp No. 3, but otherwise the men from Mana village (10,000 feet), some of whom were coolies who had been with me previously in 1911 and 1914, behaved very well, and indeed were the mainstay of all the hard work carried out. On three occasions at Camp No. 4 we had about a couple of inches of fresh snow, the bulk of which quickly evaporated.

At the base camp I tried to get coolies to come and pitch a camp on a pass between the Raikana glacier and the Ganeshganga valley to the north, from which one could carry out experiments with the oxygen cylinders and Prof. Hill's rubber bag on a beautiful snow-peak 21,700 feet high, which evidently could be climbed. Even a heavy snowstorm could have been weathered in such a position, but the coolies refused to obey the transport officer, and would not even transport wood a distance of 3 miles to a base camp below the Ganeshganga peak mentioned. In addition to this, when on two consecutive days the yakmen had driven off their yaks unloaded, and men had to be sent after them to bring them back, it was evident a retreat was necessary.

We therefore made a double march to Niti on October 1, and on the following day reached Malari, a large village about 10 miles to the south. I had not agreed to the retreat from the Raikana glacier until the transport officer had promised to try and make an arrangement at Malari to visit the Bagini glacier to the south-east, and form a high camp on a suitable mountain for carrying out experiments, and I had fixed upon Dunagiri Peak (23,184 feet), the finest mountain of that region, for the purpose.

On October 3 we moved south from Malari, and on the 5th reached Dunagiri village (11,150 feet), about three days' march from the mountain of the same name. It soon became evident, however, that the Dunagiri men were somewhat inefficient coolies and knew nothing of snow work, so that the idea of forming a camp at 20,500 feet on Dunagiri was abandoned, and a camp formed at 18,000 feet on a more accessible mountain about 21,000 feet high to the north-west of the Bagini glacier.

About a week's work was carried out at this high camp, and Dunagiri was regained on October 16. From there continuous travel *viâ* Joshimath, Karuprayag, and Ranikhet brought us to Kathgodam on the 5th, and thence to near Darjeeling on November 9, after an absence of four and a half months.

I. *Experiments with Cylinders of Compressed Oxygen.*

On testing the weight of the oxygen cylinders at Kathgodam it became evident that they were almost certainly too heavy for high altitude work.*

* They are nearly three times the weight of the cylinders previously shown to me, and had I known that these alone were available I would have cut down the number requisitioned from seventy-two to twenty-four, I quite recognize, however, that everything was done that was possible in the circumstances.

Their weight (16 lbs. approx., or with pressure regulator, etc., nearly 20 lbs.) is as much as most coolies care to carry as a load even at 20,000 feet. Preliminary experiments at 21,000 feet on Kamet confirmed that they were unsuitable, but no opportunity of working out systematic experiments occurred until after reaching the camp at 18,000 feet, near the Bagini glacier.

Experiments were carried out over three different courses: (1) a long course involving an easy snow ascent of 3000 feet (approx.) and return; (2) a medium course involving an ascent of 600 feet over rough snow, and return by a rock scree; and (3) a short ascent along a stony arête of about 200 feet.

In a typical experiment over the long course coolies took 2½ hours without oxygen cylinders, and 3 hours 40 minutes using oxygen cylinders, the use of oxygen being stopped at the summit.

Most of the experiments were carried out on the medium course, and the results were consistent. In one typical case 39 minutes were required with an oxygen cylinder, and 28 minutes without it, and a different man took 43 minutes with a cylinder and 30 minutes without.

On the short course typical results were 8 min. 20 sec. without cylinder, and 10 min. 30 sec. with it; and 8 min. 20 sec. without, and 11 min. 20 sec. when using one.

The conclusion from above results must obviously be that the cylinders are too heavy for use above 18,000 feet, and below that altitude they are not required. They would be quite useless during an attempt on Mount Everest.

It would seem advisable in the circumstances to carry out experiments with cylinders of double the capacity filled to half the pressure, so that a light cylinder similar to that shown to me in 1919 by Colonel Stewart could be safely employed. A volume of 140 litres (*i.e.* 5 cubic feet) of oxygen might be helpful, if the weight of the cylinder were not above, say, 7 lbs.

II. *Prof. Leonard Hill's Rubber Bag and Oxylith.*

Two sets of experiments were carried out. In the first set the subjects breathed oxygen from a freshly filled bag containing strong solution of caustic soda for about five minutes, shaking the bag from time to time to promote absorption of carbon dioxide. They then immediately started up the short course mentioned above—the stony arête—and returned to the starting point, the time required being noted. After about fifteen minutes a repeat experiment was carried out without breathing from the bag.

As a rule the times were practically identical, so that it seemed that no benefit accrued from breathing oxygen while resting, and that the excess amount in the lungs at starting was of negligible value in promoting ascent.

Such a result might be expected from theoretical considerations. In the experiments of the Anglo-American Expedition on Pike's Peak (14,100 feet), it was found that about 345 c.c. of oxygen * per minute was required by the body when standing erect, and that nearly six times as much (1940 c.c.) was required when ascending a gradient of 1 in 4. The healthy body at rest would therefore probably have little difficulty in providing itself at 18,000 feet—and probably even up to 30,000 feet—with the necessary oxygen; but it is obvious that the great increase required immediately an ascent is started would be practically uninfluenced by any small residue of oxygen in the lungs.

* This is substantially the same as the values found by Haldane and by Zuntz for near sea-level.

The second set of experiments were carried out while breathing continuously from the freshly filled bag during the ascent. The apparatus was carried under the arm, which was inconvenient.

In this case the gain while using oxygen was quite decisive, the advantage being up to 25 per cent. This again was to be expected, and clearly indicates that the light oxygen cylinders suggested above might be of considerable value as regards increase of rate of ascent at high altitudes. It is also evident that if such light cylinders cannot be obtained a modified form of Hill's bag, of considerably increased capacity—say, 150 to 200 litres—might be of use. Such a bag should preferably be made so as to tie on the back, the mouthpiece being brought over the left shoulder. The absorption of the carbon dioxide by caustic soda should be adequately arranged for.

It might therefore be recommended that bags of the type indicated above should be tested next year on the expedition to Kamet. Only two such bags would be required.

III. *Observations on Mountain Sickness.*

Contrary to the author's observations in previous expeditions, mountain sickness, in one form or another, was not uncommon. Two reasons explain the difference. In the first place, in previous expeditions picked hillmen were employed, whereas in this case several men from near the plains were present; and in the second place, most of the coolies in preceding expeditions were Buddhists, who can vary their diet, whereas on this occasion the men were Hindoos, and handicapped by a comparatively rigid diet which in some respects is unsuitable for high altitudes, unless under special conditions, difficult to arrange for. As it is extremely difficult to cook the nitrogenous vegetable foodstuffs above 16,000 feet, fresh mutton should be supplied.

IV. *Acclimatization to High Altitudes.*

Satisfactory acclimatization to the maximum altitude reached was attained by only two members of the expedition, namely, Major Morshead and myself. This is probably in some measure well shown by pulse and respiration rates, which were always taken at rest while sitting.

The time spent at the highest camp (22,000 feet), however, two and three nights respectively, was insufficient to arrive at definite conclusions as to the completeness of our adaptation to that altitude. In connection with the projected ascent of Mount Everest (29,141 feet), it is obvious also that capacity for acclimatization should be tested at higher altitudes, and next year the author hopes that it may be possible to camp for a week just below the Kamet saddle, at an elevation of about 23,400 feet.

A few cases of Cheyne-Stokes breathing were observed, although as a rule at least twenty-four hours were allowed for acclimatization to take place before making observations.

V. *Suitable Diet for High Altitudes.*

In previous expeditions it had been observed that a depreciation of appetite seemed to occur after residence for some time above 20,000 feet. As it was possible that this might have been due to the diet, which had consisted entirely of tinned foods, chiefly cold because of difficulties regarding fuel transport, an attempt was made on this occasion to get an approximation to the diet usually taken at sea-level as already mentioned. Fresh mutton and

vegetables were used at the higher camps, and the food varied as much as possible. The effect was distinctly good, and no diminution of appetite was observed, even at the 22,000-feet camp; but, as already indicated, the time spent there was too short to form a definite opinion as regards completeness of acclimatization.

During the ascent to the saddle our appetites seemed good, but we had little time for halts, because of the amount of step-cutting necessary, and there was also a very cold wind. As liquid refreshment, we had a large Thermos flask filled with hot Bovril.

As a rule when camped on snow the fuel used is petroleum or methylated spirit, generally the latter, and in conection with the proposed ascent of Mount Everest we wished to find out whether a Primus lamp could be used above 21,000 feet. We had two Primus stoves with us of somewhat different constructions, and both worked well at 18,500 feet. At 21,000 feet the better of the two was fairly satisfactory, but at 22,000 feet we could not get it to work at all, and had to fall back upon a lamp burning methylated spirit. Next year, by employing flat slabs of stone as hearth, it might be possible to utilize wood at the camps on snow.

VI. *Experiments with Major Flack's Mercury Manometer to test any Variation of Strength and Energy with Increase of Altitude.*

Major Flack's apparatus can be so easily employed, that it was intended to carry out experiments with it even on the summit (25,447). The difficulties regarding transport already detailed, however, prevented results being obtained above 21,000 feet.

Observations showed that the expiratory force does not seem to vary at all with altitude up to 21,000 feet, but, as was to be expected, the capacity for sustaining a 40-mm. column of mercury rapidly diminishes as one ascends. The times during which the breath can be held at different altitudes were also taken: they should probably be approximately comparable with those for the 40-mm. column. The nose was held or clipped during the latter experiments, a procedure which experience shows to be absolutely necessary.

The results show clearly that the expiratory force is about the same at 21,000 feet as at 1600 feet. As a large proportion of the trunk muscles are involved in the expiratory effort, their tone and capacity for exerting force for a short period is apparently unaltered, and therefore probably the same is true for all the muscles of the body. If, when at high altitudes, however, one tries to keep the column of mercury at its maximum height, fatigue appears to supervene much more quickly than at sea-level, presumably because the oxygen supply to the muscles and brain is less; there is, however, a fairly rapid recovery.

One would not, of course, expect the time of maintenance of the 40-mm. column or the time of holding the breath to be the same at different altitudes, and the Table of Results showed a rapid diminution of capacity in both cases. One might reasonably suppose that the normal times in each case would be approximately proportional to the alveolar oxygen pressures, but the time of support of the 40-mm. column would be less than that of holding the breath for various reasons, perhaps more especially because the muscles in action would be using more oxygen, and the oxygen of the "dead space" would have less chance of being utilised.

Summary of Variation of Alveolar Oxygen Pressure and Times of holding the Breath with Altitude.

Place.	Altitude. Feet.	Calculated normal alveolar * oxygen pressures, mm. of mercury.	Times of holding the breath in seconds. Morshead.	Kellas.	Sobhan Singh.
Kathgodam	1,600	95·5	—	82, 85, 93	—
Chomoli	3,620	87·5	50	—	—
Juma Gwar	8,250	71·0	60	67	50
Raikana Glacier ...	15,380	50·7	31	46½	26
Camp No. 3	18,500	43·2	25	42	25
Camp No. 4	21,000	37·9	—	33	23

VII. *Rate of Ascent.*

The times of holding the breath, and the alveolar oxygen pressures at different altitudes, are obviously connected with the possible rates of climbing, and it could be shown that, assuming 1000 feet change of altitude per hour on easy ground to be an average rate of ascent at the summit of Mont Blanc (15,780 feet), the rate at 23,000 feet would be about 600 feet per hour. On this occasion, excluding halts, our speed was only a little above half that value, viz. 320 feet per hour, but, considering the amount of step-cutting necessary, this was about what would have been expected. On previous expeditions the author has found that his rate of ascent on easy snow at 23,000 feet approximated to 600 feet per hour, agreeing with Longstaff's experience on Trisul. On such a basis, the calculated rate of ascent for the last 1000 feet of Mount Everest would be between 250 and 350 feet per hour. Possible rates of ascent may be further tested and elaborated in next year's report.

VIII. *Variation of Minimum Temperature with Altitude.*

Raikana Glacier.			
Base Camp No. 1	15,380 feet	31–8–20	Min. 30° Fahr.
2nd Camp	16,800 ,,	4–9–20	,, 23° ,,
3rd ,, ...	18,500 ,,	9–9–20	,, 15° ,,
4th ,, ...	21,000 ,,	12–9–20	,, 4° ,,
5th ,, ...	22,000 ,,	19–0–20	,, −15° ,,

THE DEATH OF MUNGO PARK

We are indebted to Viscount Milner, Secretary of State for the Colonies, for the communication of the following despatch from Sir Hugh Clifford, Governor of Nigeria :—

Government House, Nigeria,
3 May 1920.

My Lord,

I have the honour to bring to your notice some interesting facts which appear to fix with reasonable certainty the date of the death of the explorer, Mungo Park, at Boussa. I enclose a note on the circumstances of Park's death in so far as they are recorded in the published account of his travels. From this it will be seen that the last recorded date in his journey down the Niger is the 19th November 1805, on which day he left Sansanding. The fact that he afterwards met his death at Boussa is established by the narrative of Amadi Fatouma and confirmed by native tradition. The story

* Calculated from Miss M. P. Fitzgerald's values, *Phil. Trans. B.*, 5, **203**, p. 359.

as it is told at Boussa is mentioned in a letter from Resident Kontagora, a copy of which is enclosed herewith. From this it appears that an eclipse of the sun took place on the morning after Park died. I am informed by the Acting Chief Surveyor, Northern Provinces (Mr. T. J. Waters), that a partial eclipse of the sun was probably visible at Boussa in the early morning of 16 June 1806. That would allow about seven months between Park's departure from Sansanding and his death at Boussa. A total eclipse of the sun was also visible at Boussa on the 29th November 1807, but it is unlikely that the journey down the Niger from Sansanding to Boussa occupied as much as two years. Nor do I think that any importance need be attached to the statement that the Ex-Alkali of Yelwa was alive at the time of Park's death. Natives of an advanced age are notoriously slipshod in their reminiscences. Obviously, too, Park could not have been alive in 1833. On the whole, therefore, there seem to be reasonably good grounds for supposing that the death of Mungo Park took place on the 15th June 1806, *i.e.* on the day before the partial eclipse mentioned above.

2. The "coin" mentioned by the Resident Kontagora is a silver medal of George III. which has been converted locally into a ring. It is still prized among the insignia of the Emirs of Boussa.

3. I have brought these facts to Your Lordship's notice in the belief that they will be of interest to the Royal Geographical Society as well as to Mungo Park's descendants, if any exist.

I have the honour to be,
Your Lordship's most obedient humble servant,
(Signed) HUGH CLIFFORD,
Governor.

The Right Honourable Viscount Milner, P.C., G.C.B., G.C.M.G.,
Secretary of State for the Colonies.

Enclosure.

The Provincial Office, Kontagora,
25 July 1919.

SIR,

In continuation of my minute (6) of 17 July 1919, M.P. 1818/1919, the following is an extract from a report by Mr. J. C. O. Clarke, dated 24th March 1913: "When Kisaran Dogo was 'King' of Boussa, a white man came down the Niger in a canoe. He gave Kisaran Dogo a large coin. When Neda his daughter was about to marry he had the coin attached to a ring as a wedding gift for Neda. Neda did not accept the present, stating that she preferred slaves, which were given to her. Kisaran Dogo kept the ring, which has been worn by every Sark in Boussa since that time. The white man (Mungo Park?) stayed a few days at Boussa and then started down the Niger; the same day his canoe was capsized in the rapids of Bubarro between Malali and Garafini. It is said that when the next day broke night immediately came on again. Ex-Alkali Lowal of Yelwa was at that time eight years old, so this would be 70 or 80 years ago."

2. The marginal note points to a total eclipse of the sun, which might be useful in establishing the exact date of the death of the explorer.

I have the honour to be, Sir,
Your obedient servant,
(Signed) W. HAMILTON-BROWNE,
Resident Kontagora.

The Secretary, Northern Provinces, Kaduna.

According to the 'Journal of a Mission to the Interior of Africa in the Year 1805,' by Mungo Park, published by John Murray in 1815, Park with Lieut. Martyn and three soldiers left Sansanding on the 19th November 1805, and continued their voyage down the Niger under the guidance of Amadi Fatouma. Park's Journal was sent back from Sansanding by Isaaco, who in 1810 was engaged by the then Governor of Senegal to return in search of news. Isaaco's journal embodied the story told by Amadi Fatouma (pp. 211 to 215 of the above work), but it is not possible to form from this account any precise idea of the date when Mungo Park was drowned in the rapids of Bubarro.

Dr. A. C. D. Crommelin, of the Royal Observatory, Greenwich, has very kindly examined the circumstances of the solar eclipses visible on the Niger in the early years of the nineteenth century. He writes: "I do not think either of the eclipses fits the native report well. That of 16 June 1806 was large at Bussa, but it occurred just before sunset, not just after sunrise. That of 29 November 1807 was total at or very near Bussa, but totality occurred at noon, with the sun 58° high. Perhaps we may allow something for the vagueness of native tradition. There was a fairly large eclipse soon after sunrise on 17 August 1803, but that is inadmissibly early. On the whole, I think a thunderstorm is the best explanation, and the 1807 eclipse the next best; the 1806 one is definitely excluded."

Dr. Crommelin's report was communicated to the Colonial Office, and thence to the Governor of Nigeria, who replied as follows:

Government House, Nigeria.

MY LORD,

With reference to the request contained in the final paragraph of the letter from the Secretary of the Royal Geographical Society, enclosed in your Lordship's despatch No. 940 of the 28th June 1920, I have the honour to say that I have caused further inquiries to be made, and I fear that no information is likely to be obtained from native tradition which might enable the date of Mungo Park's death to be fixed with certainty. It is extremely probable that the facts of the total eclipse of 1807 and the death of Park in 1806 have become connected by legend, and the eclipse which really happened the next year may easily after such a lapse of time have come to be spoken of as having happened the next day.

I have the honour to be,
Your lordship's most obedient humble servant,
(Signed) HUGH CLIFFORD,
Governor.

The Right Honourable Viscount Milner, P.C., G.C.B., G.C.M.G.,
Secretary of State for the Colonies.

It appears therefore that the promised clue has led to nothing definite, and that the precise date of the death of Mungo Park will remain unknown.

MAP PROJECTIONS

Some Investigations into the Theory of Map Projections.— Alfred Ernest Young. R.G.S. Technical Series, No. 1. London: R.G.S., Kensington Gore, S.W. 7. *Price* 6*s. net.* To Fellows 5*s. net.* vii. + 76.

THIS book of seventy-six pages, some of which are very condensed, is the most important contribution to the subject of map projections that has appeared in English for many long years; and it is especially to be welcomed as it is the first of a projected series of publications to be issued by the Society, the series being "designed to include important contributions to geography too technical and too long for the *Geographical Journal*." The series begins remarkably well, and, if it continues as it has begun, the Society will be able to congratulate itself on assisting in the production of important additions to knowledge.

The writer, Mr. A. E. Young, is well known as a mathematician who has devoted himself to the study of technical survey problems. He was for many years in charge of the trigonometrical and scientific side of the work of the Survey Department of the Federated Malay States. Mr. Young describes, in the preface, how he was led to investigate the theory of map projections by being asked by Mr. Hinks to compute some tables required for the new map of Africa on the scale of one to two million. This happy chance has resulted in investigations of a really important and original nature.

The main purpose of the book is the investigation of a greatly extended application of Airy's principle of Balance of Errors. It is, of course, well known to map-makers that Airy's principle aims at the construction of a projection that shall represent neither areas nor small outlines correctly, but shall be, as it were, a sort of golden mean. We must imagine that at every point on a map there are always two errors of scale to be considered, in two directions at right angles to each other, usually, for convenience, the two directions are chosen along a system of great circles and at right angles to them. Roughly speaking, Airy's method is to make the average scale error a minimum over the portion of the sphere represented. The principle has much to recommend it, but the objection may be urged against it that it does not make the *largest* scale error a minimum.

Airy applied the principle to the "zenithal" class of projections; Mr. Young has successfully applied it to the general conical class, of which the zenithal is only a particular case. Moreover, Mr. Young has been able to apply the minimum-error principle to zenithal projections of which the form has already been determined, such as the zenithal orthomorphic and zenithal equal-area projections. This latter process may be looked at somewhat in this way: Suppose that we have calculated a zenithal equal-area projection and plotted it on paper and drawn a scale on the same paper; the scale so drawn will be in terms of the radius of the Earth equal to unity, where unity is some definite length on paper. Everything is now fixed, and if we still keep the radius equal to unity, however we may enlarge or reduce the map and scale together, the projection remains the same. Or, in other words, so long as we keep the scale at the "centre" of the map true we have no means of improving the projection. But suppose that we alter the scale at the centre; this is the equivalent of leaving the projection as it is but *redrawing the scale.* If we allow ourselves this freedom we can choose that scale which, given the condition of equivalence, shall result in the smallest average linear

scale error. This is what Mr. Young does, and we are immediately introduced to the zenithal equal-area minimum error projection, and similarly to the zenithal orthomorphic minimum error projection, and the zenithal equi-radial minimum error projection. Clarke had already given us the minimum error perspective projection. Dealing with this group of projections, the writer makes the remark that it may appear more natural to find the average error by integrating over the surface of the map rather than over the corresponding surface of the Earth, an idea which is probably valid, and has no doubt occurred to many who have studied Airy's Projection. He then shows what small differences may be expected in the resulting projection.

The author next deals with the more general problem of the application of the minimum-error principle to conical projections, and this is the longest, and perhaps the most interesting, portion of the book. In a conical projection the parallels are incomplete portions of concentric circles and the meridians are their radii. It is required to find the values of these radii for the different parallels, given a particular "constant" of the cone, the constant of the cone being the proportion which the angle between any two given meridians bears to the true difference of longitude. If we can dispose of the value of the constant of the cone, we have another degree of freedom. After a discussion of the general formulæ, the author gives a numerical example (on the spherical assumption), which may be quoted as giving us an idea of the kind of error involved. Taking a map extending from the equator to latitude 60°, a minimum-error conical projection, by balance of errors, will have a maximum scale error on the upper parallel of $+12\cdot5$ per cent., $+8\cdot7$ per cent. on the lower parallel, and $-4\cdot5$ per cent. on the mid-parallel.

The reviewer is inclined to think, without in any way minimizing the great theoretical value of Mr. Young's investigations, that the practical map-maker may be well advised to consider, not the average scale error, but the maximum scale error. It appears, indeed, in the general case, not unfair to judge of a projection by its maximum scale error.

But Mr. Young has not entirely neglected practical considerations. He points out, for instance, how the errors of our old friend the Cassini projection can be lessened by reducing the scale error along the principal meridian by one-third of the scale error at the extreme east or west of the map, thereby making the average linear error a minimum; a kind of device already used in the projection for the International Map. Space does not allow of an adequate account of this section of his work, which is full of good things, notably the re-establishment of the value of Murdoch's two projections, (A.D. 1758), which were treated with less than justice by Germain.

An important contribution to the study of projections is the investigation (which extends to some eight pages) of the spheroidal formulæ for the conical orthomorphic projection with two standard parallels. Those who are acquainted with the technical work of the survey battalions on the Western Front will remember that it soon became evident that orthomorphism was a useful quality in a military map. Steps were, in fact, being taken, when the Armistice was signed, to convert our maps, which depended upon the Belgian Bonne projection, into orthomorphic terms. Mr. Young has now given us the full formulæ for the spheroid, and they will be found of real value. A mental note should be made by all interested in military maps that the investigation of the formulæ of this useful projection is to be found in the work under review.

To sum up the impressions derived from an attentive perusal of Mr. Young's paper—we have in these investigations a series of original studies which must

in future be read by all interested in the subject of map projections. Most of them are concerned with the principle of smallest average error, and Mr. Young has greatly extended the application of this principle. He has also been the first to point out the radical importance of the proper use of the "scale constant"; he has given us a full examination of the spheroidal formulæ for the conical orthomorphic with two standard parallels, and has re-established Murdoch's reputation. C. F. C.

THE WESTERN SAHARA

Société de Géographie.— Captaine Augiéras. Le Sahara Occidental. Paris: Masson et Cie. 1919. Pp. 48. *Map.*

IN this brochure Captain Augiéras sets forth, with great lucidity, the knowledge gained by French officers in the Western Sahara since the opening of the twentieth century. Among these officers the most notable are Captain Flye-Sainte-Marie, General Laperrine, Captain Martin (who died of thirst in the desert, the fate which through an aeroplane accident subsequently befell General Laperrine), and Captain Mougin. These and a few other officers have given us all the exact knowledge we possess of that part of the great desert.

The reader, however, soon discovers that the author uses the term "Western Sahara" in a restricted and somewhat arbitrary sense. He excludes the whole of the coast region, Mauritania, and the area around Timbuktu, while including part of the Moroccan Sahara. On the east the limit adopted is the wadi Saura-Messaud and the Tanezruft south of that wadi.

Within the limits indicated the Western Sahara covers some 386,000 square miles, being nearly double the size of France. Much of it still remains unexplored, but its general characteristics are now clear. In the centre is a crystalline plateau of moderate elevation, "the eruptive zone of the Eglabs, which may be said to form the dome of the country." This "dome" (no indication of its height is given) is surrounded by a lower region in great part covered with sand-dunes—the Juf on the south, the Erg Igidi to the west and north, the Erg Shesh to the east. Rocky plateaus rise north-west of the Igidi, to the north-east a series of parallel folded ridges (Hercynian) separate the Igidi from the valley of the Saura. Farther north the last bastions of the Atlas mark the end of the desert. And in the Western Sahara desert conditions are much accentuated, oases scarcely exist save upon its periphery. It is without inhabitants; "one may travel in it for months without meeting a single human being." Large areas, including much of the central "dome," are indeed devoid of any kind of life, either animal or vegetable. But in general the Ergs, the hills, and the hammadas have both flora and fauna; some of the hammadas are even "relatively alive. One likes to pitch one's tent there." The date-palm grows in the Ergs, the "talha" (*Acacia tortilis*) in the jebels and hammadas, in some places even forming the semblance of a wood. In the wadis the tamarisk (*T. articulata*) is found. There are several small shrubs and plants, one of the latter with a pretty violet-coloured flower. The chief animals are antelope and moufflon. The leopard is occasionally seen; reptiles and insects are numerous. There is a fly whose bite is sometimes fatal to camels. Captain Augiéras states that the temperature is "particularly high" because the Western Sahara is a depressed region, in which the dunes

rapidly absorb an enormous quantity of heat, which is given out with equal rapidity. Hot as is the air, the soil is still hotter, and one cannot walk barefooted without getting badly burned. Winter temperature appears to be about 25° lower than the summer, and on two or three nights in the year there may be frost. Rain falls perhaps once a year; dry tornados, with the sky opaque for days together, occur in the summer.

Although now uninhabited, the Western Sahara still contains habitable tracts. All the evidence goes to show, however, that it is becoming increasingly arid. There is the skeleton of the old river system, concerning which Captain Augiéras confirms the conclusions of other observers already recorded in the *Journal.* The " innumerable indications " of former habitation are almost all pre-Islamic, but there are traces of baked mud houses certainly not more than two hundred years old. Tradition has it (though this is not mentioned by the author) that there were settlements in this part of the Sahara up to a much more recent date. There are routes across the desert between the Niger and Morocco along which water can be obtained, and for many centuries the country was traversed by large trading caravans to and from Timbuktu. It was with one such caravan that René Caillié made the journey to Tafilet in 1822. In that caravan were some 1400 camels, and the journey lasted seventy-five days.

How long after Caillié's journey this route was used the present writer has not been able to ascertain ; it would be of interest to know. The only other complete traverse of the Western Sahara between Morocco and the Niger was made by Oskar Lenz in 1880. Unfortunately neither Caillié nor Lenz was able to give any detailed geographical data, and presumably we shall have to wait for the complete pacification of Southern Morocco before a thorough scientific investigation of the Western Sahara is possible.

For such work as French officers have been able to do in the last twenty years has been only what inclination prompted and militaty duties permitted. It might be supposed that there was no call for military work in an uninhabited region—where not even the nomads who live on its borders take their herds to graze. But the country is still used as a highway by Moroccan bandits, who make annual raids on the Sudanese tribes in the Timbuktu region and the Berber tribes of the Adrar of the Iforas, to protect whom the French have organized a special service. It is one of the ironies of the pacification of North-West Africa by the French that it put a stop to the last of the trading caravans which used the Western Sahara—that from South Morocco to Tuat, though Captain Augiéras looks forward to the time when with the occupation of Tafilet trade will revive.

Meantime the bandits lead a merry life. Their knowledge of the country, their endurance, the suddenness of their descent on unsuspecting tribes, puts all the trumps in their hands. And they have no sense of shame—they fly at once if they think they are the weaker party. The Meharists may go in hot pursuit, keeping up the chase for hundreds of kilometres, but " often without result." The bandits moreover, if pressed, resort to an excellent stratagem—they disperse in small parties in the immensity of the desert. " In which case the troop in pursuit has nothing to do but to stop—and keep rigorous guard during the night." All the raids are made from Morocco to the Sudan—there are no known itineraries between Mauritania and Tuat.

Captain Augiéras devotes the second part of his paper to a detailed account of the construction of the map. Every care has been taken, and the map itself (1/500,000) is the best we have of the Western Sahara, though its author,

who has now for seven years been exploring the country, speaks of it modestly as but a first approximation to exactitude. But, as he adds, it gives a general idea of the region, the distances to be covered, and the difficulties to be encountered. It still has many blanks—the Juf, the Tanezruft, and other regions remain unknown. Africa has not yet yielded up all her secrets.

FRANK R. CANA.

REVIEWS

EUROPE

The Russian Almanac, 1919.— Compiled and edited by **N. Peacock.** Pp. 209. Published for the Anglo-Russian Trust by Eyre & Spottiswood London. *Price* 5*s. net.*

PUBLICATION of the Russian Year-Book was suspended in 1917, and now Miss Peacock, its editor, has undertaken the difficult task of compiling a work of reference on Russia as it is to-day. The volume includes some survey of Finland and Siberia, as well as all the European territories which formed part of the late Russian Empire. Russian statistics were never noted for trustworthiness, and now they are practically unobtainable. In many cases figures of the past era in Russia are given for want of more recent information. Making allowances for these difficulties, we have found the information accurate and useful. A short list of books on Russia might be amplified by a note on maps. The addition of a few maps would enhance the value of this volume. The lack of an index is a serious omission. R. B.

ASIA

Annals and Antiquities of Rajasthan.— **Lieut.-Colonel James Tod.** Edited with Introduction and Notes by **W. Crooke, C.I.E.** In 3 vols. Oxford: University Press. 1920. *£*2 12*s.* 6*d. net.*

On its first appearance this well-known work was noted by a sympathetic reviewer as standing out, in form and matter, from its contemporaries "in an age of duodecimos." Glancing from the lordly quarto which has delighted several generations of students of Indian life to the handy octavo in which it is here presented, the comparison suggests itself between the opportunities afforded by the spacious times of the author's service in India and those which now fall to the lot of his more migratory official successors of to-day. Tod was in India from 1798 to 1822, without a single day's leave, and all but the first seven years were passed in the tract of which he writes. It was in a state of anarchy and transition, and for the greater part of his sojourn there his life was "a tissue of toil and accident." Nevertheless, his intensive study of the region and its peoples was unflagging. He was steeped in grain in the traditions, customs, and balladry of the chivalrous and romantic communities of whose interests he was in charge, so that "wherever his eye fell, it filled his mind with images of the past." His great work is not, of course, without shortcomings, of which some must be ascribed to the author himself, but more to the time in which he lived, when the systematic study of ethnology, epigraphy, and social life generally was in its infancy. Taking the Annals as a whole, however, it may be said of them, as has been said of Macaulay's two Indian Essays, that inaccuracy in facts is apt to be taken as venial in the enjoyment of their literary charm.

The work, then, is well worth the tribute of being brought up to date in regard to the subjects of which our present knowledge is substantially the

result of research maturing within the last thirty years. This task could not have fallen into hands more capable or more sympathetic than those of Dr. Crooke, the leading authority upon the ethnology, folk-lore, and historical literature of Upper India. He deals faithfully, as he was bound to do, with his author's too facile endorsement of the authenticity of bardic effusions, as with his frequent and rash pursuit of analogy—that Will-o'-the-Wisp of anthropological and linguistic research. He is careful to point out, however, that Tod was here not sinning against the light of his age, and refers to questions of far-reaching importance on which his author was the first to form, or at least to indicate, conclusions which modern investigation has amply confirmed—for instance, the Scythic origin of the leading Rajput clans, and, again, the contrast between the beliefs of the Hindu masses and those of the Brahmans. Dr. Crooke does full justice, as is to be expected of him, to the vivid descriptions Tod gives of the chief religious festivals and ceremonies of Rajasthan, with the tradition of their respective origins, and dwells upon the unique value of the picture here given of a state of society which, within a generation or two after he had placed it on record, had passed away. In conclusion, the editor deserves commendation for the tactful way he has interpolated unobtrusively his numerous essential corrections and additions, without interfering with the enjoyment of his author's more voluminous footnotes. In this way, and by his scholarly introduction, he has gone far to add a new lease of popularity to what he entitles justly the most comprehensive monograph ever compiled by a British officer, describing one of the leading peoples of India.

J. A. B.

The Diary of a Sportsman Naturalist in India.— E. P. Stebbing. Pp. 298 + xvi. *Illustrations.* London : John Lane. 1920. £1 1*s.* 0*d. net.*

This is a volume of rambling reminiscences of many years' big-game hunting in Indian jungles. Mr. Stebbing has a lively style which makes his volume good reading, and he is well versed in his subject and has a genuine love of the wild life whose ways he faithfully records. To a sportsman the book will be enthralling from cover to cover, but the naturalist also will find much to interest him. The chapters on jungle lore are of special value. The last part of the book is devoted to questions of game protection and the provision of sanctuaries for the preservation of the Indian fauna. Here Mr. Stebbing takes a wide outlook, and pleads not only for animals of sporting and economic values, but also for the fauna generally. He discusses at length the scanty measures that have been taken locally and the Indian Wild Birds' and Animals' Protection Act of 1912, which he shows is woefully deficient in its scope and powers. The greatest enemy of wild life in India is the native poacher, whose diabolical ingenuity Mr. Stebbing describes. The law at present seems to have little power to touch him. To save many large and small forms of animal life from extinction permanent sanctuaries are required. Areas of primeval forest untouched by man must be left in their original condition. The depredations of sportsman and native poacher and even the felling of trees or other waste must be prohibited if these sanctuaries are to fulfil their purpose. Some excellent photographs and many thumb-nail sketches add to the interest of the book.

R. B.

The Harvest of Japan.— C. Bogue Luffmann. London : T. C. & E. C. Jack, Ltd. 1920. 12*s.* 6*d. net.*

This book is a volume of very unequal value, its chief recommendation being the interesting information gathered by the author with regard to such

topics as the dwarf trees and gardens of Japan. Apart from that it need hardly be regarded as a serious contribution to our knowledge of the country with which it deals.

Inaccuracies abound on almost every page, and we sometimes wonder how far its author expects to be taken seriously. Indeed, one is at times inclined to suspect that 'The Harvest of Japan' which he offers us is mainly composed of chaff. He tells us, "I am a traveller . . . out with strange gifts, offering surprises, out to make discoveries." Surprises we are certainly provided with when we are told that "the Japanese are as amphibious as fish"; "laughter is a comparatively modern accomplishment"; "Modern schools! . . . Fool factories, that is what I call them." His strangest "discovery" of all is that "The Japanese claim they are derived from the Ainu," a statement the exact contrary of the fact. Perhaps we may fitly close this notice with the writer's own query, on the last page but one: "If in some of these pages there is more of the writer than of Japan, may I not ask, 'Is not the traveller the thing'?"

W. W.

AFRICA

An Introduction to the Geography of Sierra Leone.— H. Michell. Freetown. 1918. Pp. 128. *Maps.*

This small book has been written by an official in the Education Department in Sierra Leone for teachers in the country. It contains a great deal of information set forth on the whole in a true geographical spirit, but the treatment of towns is a little reminiscent of a gazetteer. There are numerous excellent maps, but the book lacks an index. If this volume has wide use geography should be well taught in Sierra Leone, even if rather local in its scope.

R. B.

A Naturalist on Lake Victoria: with an Account of Sleeping Sickness and the Tse-tse.— Dr. G. O. Hale Carpenter. London: T. Fisher Unwin. 1920. 28*s*.

This is a very valuable contribution towards the solution of the problems concerning the distribution of germ diseases by tsetse flies; together with studies of mimicry in the coloration of insects, especially the polymorphic mimetic butterflies. The scene of Dr. Hale Carpenter's studies was the Sese archipelago of islands which follows an almost parallel direction with the mainland coast of the Victoria Nyanza in the north-west and north. These Sese islands—there is no need for the double *s*—seem to be the vestiges of a former right bank of the infant Nile (known to us as the Kagera), before the vast expanse of the Victoria Nyanza was formed. At the present day there is a perceptible current passing between the coasts of Buganda and the Sese islands which continues to the outlet of the Nile at the Jinja falls.

These islands, together with Buvuma near the Napoleon Gulf, became much associated with the terrible outbreak of sleeping sickness which, beginning in 1901, carried off thousands of the Baganda population and led in fact to the virtual extermination of the Basese, an interesting folk inhabiting this archipelago and speaking an archaic Bantu language. The Sese islands also were the home of a marsh-dwelling aquatic Tragelaph, originally discovered by Captain Speke. This long-hoofed relation of the Kudus and Bushbucks nourished in its blood not merely one but two of the Trypanosomes that are the cause of sleeping sickness and allied diseases fatal to goats. The tsetse fly acts as the intermediary for the distribution of these fatal trypanosomes, not only from the blood of this Tragelaph (*Limnotragus spekei*), but from that of

other antelopes. The blood of the crocodile, so often sucked by tsetse flies, seems to contain only a trypanosome of a harmless nature.

The author does not seem to favour the extirpation of Speke's Tragelaph or of other antelopes as a means of putting an end to the sleeping sickness. He prefers the institution of measures for the extirpation of the tsetse fly. This he maintains can be done by inducing the fly to deposit its pupæ in prepared places and then digging them up and destroying them. The tsetse, like some other insects and certain fish and reptiles, is an anticipation of the Mammalian plan, in that it does not lay eggs but hatches the egg within the body cavity, feeds the fœtus on special juices, and then extrudes a larva which it pushes into the soil to continues its growth as a chrysalis.

The studies of monkeys and their sound-language, of birds, butterflies, fish, and other creatures found on these islands or in their surrounding waters are among the most original and interesting additions to our knowledge of African natural history I have read. This is really a very valuable book. If our British Academy had any life in it or any interest save in rather useless *belles-lettres*, it would crown such a work for its interest as well as its practical value.

H. H. JOHNSTON.

Among the Ibos of Nigeria.— G. T. Basden, M.A., F.R.G.S. London: Seeley, Service & Co. 1921. 25*s. net.*

This well-illustrated book gives an interesting account of the life and customs of the Ibo by a missionary of twenty years' service, and it will prove of value alike to the ethnologist and geographer. The main part of the Ibo country roughly lies between the Niger and Cross river from the coast to 7° N. lat. The southern portion is a typical tropical delta area, with rank vegetation and a humid, enervating atmosphere. The greater part of the interior is hilly, with a vegetation chiefly of scrub and jungle grass and patches of moorland, the red soil sandy and of poor quality for agricultural purposes. On the western side of the Niger the land is at a lower level, much more fertile, and a large part is covered with forest. Game is scarce, and elephants, once abundant, are now almost extinct. In the eastern districts the natives are inclined to be thin and scraggy, but in the west they are shorter and thick-set. There is a great range of skin-colour. On the left bank of the Niger society is chiefly constructed on patriarchal lines, each town and family being independent, and, with the exception of the king of Onitsha, there are no kings; on the opposite side of the river native rule is maintained by kingly authority. The Ibo are a sober people, and do not brew any intoxicating liquor; but drunkenness is on the increase, brought about entirely by the introduction of foreign spirit. In the south, human flesh was a marketable commodity and a common article of diet. The dry season is devoted almost entirely to leisurely pursuits; it is also the time when the young men start raiding and fighting. With the approach of the rains a truce is declared, both parties recognizing the obligation to attend seriously to farming. A month of steady work brings the farm into order; but the women are expected to do most of the weeding. The heavy work of puddling clay for housebuilding is the work of the men. Every free-born youth on arrival at puberty becomes a recognized citizen, and is bound to bear his share in all that pertains to the welfare of his tribe in times of peace and war.

Yams, though singularly deficient in nutritive value, form the staple and favourite food; tradition says that they were introduced by the Portuguese. In comparison with the yield, their production entails a large acreage and strenuous and continued labour; were it not for intermediate crops of maize

and beans and a subsequent catch-crop of cassava, it is doubtful whether yams would repay cultivation. Possibly other products will be grown which will be more profitable and can be exchanged for imported foodstuffs. It is interesting to note that the self-sown oil palms go with the land when it is transferred by purchase, but coconut palms remain the property of those who planted them. In the chapter on trade and currency we read that in the south and east there was a strong demand for manillas and brass rods; in the north and west cowries were, and still are, the most popular form of currency. For facility of trade the introduction of a metal currency is a great boon to the white trader; but many natives refuse to sell at all except for cowries, and it will be a long time before they are finally displaced by a metal coinage unless forcible measures be taken. Mr. Basden points out that the whole political economy of the country is passing through a great transition stage. A. C. H.

AMERICA

In Lower Florida Wilds.— C. T. Simpson. Pp. 404 + xvi. *Illustrations and Maps.* New York: G. P. Putnam's Sons. 1920. $3.50.

Over twenty years of observation in Lower Florida have enabled Mr. Simpson to write a charming volume on the natural history and physical geography of that region, including the Florida Keys. The wild fauna is rapidly disappearing as the tide of population flows southward and the forests are cut down, the streams dredged, and the swamps drained.

MATHEMATICAL GEOGRAPHY

Mapping from Air Photographs.— [Lieut.-Col. M. N. MacLeod, D.S.O.] Issued under the authority of the General Staff, War Office, London: Published by His Majesty's Stationery Office. 1920. Foolscap Folio. Pp. 66. *With Plates. Price* 4*s. net.*

This excellent publication deals in detail with the methods of mapping from air photographs of which a summary was given by Colonel MacLeod in the *Geographical Journal*, **53**, 382. It is stated rather inconspicuously on the second page of the cover that the work "has been compiled by Lieut.-Col. M. N. MacLeod, D.S.O., M.C., R.E.," but it seems to us that the word "compiled" hardly does justice to the merits of the author, who is not only responsible for devising the best procedure of any Field Survey Battalion on the Western Front, but was able in the comparative leisure of the Army of Occupation on the Rhine to ponder the theory, and devise the improved apparatus here first described.

The theory of the rectification of photographs that should have been taken vertically, but are really tilted several degrees in an unknown direction, involves propositions in the theory of perspective which are not readily accessible in convenient form. Colonel MacLeod has done excellent service by thinking them out and bringing them together in a style which is probably as clear as can be attained in this somewhat forbidding subject; forbidding at least until one begins to handle the apparatus and the photographs, when it soon becomes fascinating. Without a clear appreciation of these propositions it is impossible to make any progress either in method or design of instrument: either in development of the camera lucida, which has certain good points, though it is not likely to survive, or in the construction of the photographic "rectifier," which embodies some curious properties of the lens with a flat field that have only recently been brought to light. At least, we do not remember that it was

ever demonstrated in the textbooks of optics that two planes inclined at any considerable angle can be made optically conjugate, one the image of the other and in sharp focus, by suitably disposing a lens of any focal length ; yet the theory, developed on page 47, is quite simple, and the practical consequence is surprising. A photograph of flat country taken at any angle from the vertical can be re-photographed with any lens giving a good flat field, into a rectified photograph such as would have been obtained with a vertical camera. We believe that the proposition was first employed by the late Captain Scheimpflug of the Austrian army, but his exposition so obviously claimed too much for the application of his method that it rather bred suspicion, and did not at once obtain the attention it deserved.

The requirements of the design for a copying camera on this principle are lucidly stated by Colonel MacLeod. But we do not think that a complete apparatus has yet been constructed in England, while we should judge that the camera illustrated in Captain Scheimpflug's paper was not adapted for convenient working. We may hope that the newly appointed Air Survey Committee will make it their business to establish a small laboratory, where this and other apparatus required in air survey may be thoroughly tried, especially in regard to rapid and easy adjustment of the distorted photographs to the ruling points.

A quick way of finding approximately the direction and the amount of the tilt is the first requirement in this work. The methods given by Colonel MacLeod are confessedly rather long, and one or two others which the reviewer had the pleasure of discussing with him during a visit to Cologne require a good deal of development, and the construction of a special drawing instrument, before they could be considered more than geometrical curiosities. There is an opening here for the ingenious geometer.

The methods discussed in this paper are suitable for large-scale work, such as trench maps in flat country ; reconnaissance survey on a small scale in a country with few fixed points is treated very summarily ; while the real crux of the problem, the determination of heights and contours, is just touched upon without any working solution being found. One naturally hopes for success from some stereoscopic method, and it is reported that the Germans used a form of the Pulfrich stereocomparator, which is well known to astronomers, though they are not altogether enthusiastic about it. In view of the poor quality of German mapping on the Western Front we may conclude that the enemy did not as a matter of fact get very far with the employment of this instrument. The use of stereoscopic pictures requires that the photographs shall be perfectly matched in intensity, and that the man who works at them shall have a pair of well-matched eyes : astronomers have failed in the latter respect. Stereoscopic methods have been applied with success in the survey at rather close range of steep inaccessible faces photographed from a fixed and measured base ; but the conditions of air survey are so different that it would be rash to assume in advance the success of a method which must be thoroughly investigated.

The General Staff should be congratulated on the printing and production of their recent technical publications. The figures are good, the mathematical printing well done, and the plates excellent. Only the forbidding foolscap size of page remains to remind us of the old Government printer.

A. R. H.

HISTORICAL GEOGRAPHY

Ser Marco Polo : Notes and Addenda to Sir Henry Yule's edition.— Henri Cordier. London : John Murray. 1920. Pp. 161. *With Frontispiece.* 16*s. net.*

The publication of a book by Prof. Henri Cordier which sheds more light on Ser Marco Polo is an important event. A generation ago, when a third edition of Sir Henry Yule's great work was projected, it was realized that his mantle had fallen on the distinguished Frenchman. Not only was the new edition of great value, showing marked progress all along the line, but it was followed up by an equally valuable new edition of 'Cathay and the Way Thither.'

In the work under review, the wise course has been adopted of publishing notes embodying the results of recent journeys by Sir Aurel Stein and others, while all literature bearing on the subject has been carefully examined by the erudite editor. As a result, material for a fourth edition of the 'Travels' has been collected and carefully worked up.

Part of the charm of Marco Polo's description of his travels lies in the number of problems which his usually brief descriptions raise, chief among them being the uncertainty as to the exact routes he followed. This meets us in the opening chapters. Did Marco Polo travel from Ayas to Erzinjan and thence *viâ* Mosul, Baghdad, and Basra down the Persian Gulf to Hormuz, then a port near Minab, or did he follow the land route *viâ* Tabriz, Kashan, Yezd, and Kerman to Hormuz ? Again, did he, when travelling northwards from Kerman, visit Tabas or not ? Friendly discussions on these questions are always interesting and are frequently fruitful in results. But yet dogmatic pronouncement is to be avoided, and while I hold to the view that Marco took the land route across Persia and did not visit Baghdad, Basra, or the head of the Persian Gulf, I should be unwilling to insist on my view being correct as against Prof. Cordier's, even though Prof. Beazley supports me.

Farther east the journeys of Sir Aurel Stein have made a most substantial addition to our knowledge of the Russian Pamirs, Roshan, Shignan and other petty states, which were sealed books to Yule. We specially note that Stein published a valuable paper on Marco Polo's account of a Mongol inroad into Kashmir in the *Geog. Journal* of August 1919, which added considerably to our knowledge of the subject.

A recent journey across the Pamirs made by Stein in 1915, when I was also travelling in those uplands, makes it clear that the exact route followed by the Venetian cannot be laid down. He evidently avoided the old-established village of Tashkurgan and probably Tagarma. Through inquiries made by me on the spot, I learned that caravans from the Pamirs generally came out at Bulunkul, where the Tashkurgan route meets various routes from the west, and such a line would fit in with the text, but it is impossible to fix the exact route. As to Kashgar, times have changed since Marco described its inhabitants as a wretched, niggardly set of people who eat and drink in miserable fashion. Owing to the construction of the Russian railway system to Andijan, Kashgar is the most prosperous oasis in Chinese Turkestan, and its inhabitants are sturdy and well-mannered peasant proprietors who enjoy plenty of feasting and music. In the onward journey Stein identifies Pein with ancient Kenan and the city of Lop with the present Charklik, and so ever onwards across the Great Desert to China.

Here this review must end, but perhaps enough has been said to show the

importance and deep interest of the work, which will appeal to readers in general and to Fellows of the Royal Geographical Society in particular.

P. M. SYKES.

GENERAL

Letters of Travel, 1892-1913.— Rudyard Kipling. London : Macmillan & Co., Ltd. 1920. Pp. 284. *7s. 6d. net.*

This is Kipling at his best giving vivid fresh impressions of America, Canada, Japan, and Egypt. It is one of those rare books, like 'From Sea to Sea,' which is almost an adequate substitute for travel in the reality it gives to unfamiliar lands : perhaps such books are even better than travel, for few can see as deeply and far as Mr. Kipling. The letters are reprinted from various sources, but they can never be out of date. Such a volume of travel permanently enriches our libraries.

Dead Towns and Living Men.— C. L. Woolley. Oxford : University Press. 1920. *12s. 6d. net.*

No one, after reading this entertaining volume, can say that the pursuit of archæology is necessarily dull. The author gives a lively account of his observations and experiences incidental to excavations carried out in Egypt and Italy and at Carchemish. The characteristics of the workmen employed and of the native peoples are described and commented on in a sympathetic, acute, and vivacious manner. The account of the Milli-Kurds is particularly interesting. The incompetence and corruption of the Turkish Government and its officials are vividly portrayed, and we can only admire the vigour and success with which Mr. Woolley met and overcame them. His power of gaining the confidence of his workmen on the one hand, and of the unruly Kurds on the other, is a tribute to his insight into human nature and his ability as a leader. His account of Carchemish and the discoveries revealed by the excavations is very clear and informing, is illustrated by a plan and several good photographs, and brings home the reality of the mysterious Hittites in a more striking way than is usual. Archæological excavation, in fact, becomes in the hands of the author a life full of incident and adventure. Mr. Woolley describes his book as "pages from an antiquary's note-book," and it may safely be said that the experiences of an antiquarian explorer are seldom described in so readable and interesting a fashion as they are in these pages.

E. A. P.

HISTORICAL GEOGRAPHY

The Story of the Blue Back Chart.— London: Imray, Laurie, Norie & Wilson, Ltd. [1920.] Pp. 20. *Facsimiles.*

In the days of the early British navigator there was no Hydrographic Department of the Admiralty to publish charts for his guidance, and he had to depend upon those issued by private publishers. The history of the production and publication of these non-official charts, so far as this country is concerned, is briefly traced in an interesting pamphlet just issued by the firm of Imray, Laurie, Norie & Wilson, Ltd., illustrated by photographic facsimiles of the titles and title-pages of some of the more important old sea atlases and charts. Attention is first called to the fact that it was to the Dutch that we were chiefly indebted for the charts and sailing directions in use by the British Navy and Merchant Service. In the year 1583 Lucas Jansz Waghenaer published, at Leyden, his work entitled 'Dė Spieghel der Zeevaerdt," which was copied by Anthony Ashley as the 'Mariners' Mirror.'

Introduced into England, this became known by a translation of the name of its author, and was the first 'Waggoner.' Later on other publications appeared, notably the collection of charts of Van Keulen, which were largely copied for the use of British navigators. It was not until 1795 that the Hydrographic Department of the Admiralty was founded, but when Admiralty charts appeared they did not wholly supersede those of private nautical publishers, which even now are in considerable demand, especially by officers of the Merchant Service. These non-official navigation charts have become generally known as "blue-backs," since they are usually mounted on blue paper to distinguish them from the official Admiralty publications.

John Seller appears to have been about the first regular chart publisher in this country, and he established himself in the reign of Charles II. at "The Sign of the Mariner's Compass, Hermitage Stairs, Wapping," where in November of 1670 was issued the first part of his famous work 'The English Pilot.' From this early pioneer of British nautical publishers, by purchase and family connection, eventually arose the firm of Laurie, from which by combining and amalgamating with other nautical publishing firms has arisen the present well-known establishment of Imray, Laurie, Norie & Wilson. The history of the different houses constituting this firm is traced separately in the pamphlet now issued, which will be read with interest. Many of the early hydrographic atlases and charts mentioned are of considerable value for historical reference, while such works as 'Norie's Navigation' and 'Findlay's Sailing Directions' have been constantly revised and are still of the greatest service.

The late Mr. D. W. Kettle, for so long connected with this publishing house, bequeathed to the Society a valuable collection of early charts and atlases, published by the different branches and predecessors of the present firm; and it is to Mrs. Kettle, his widow, that we are now indebted for the copy of this interesting little history. E. A. R.

THE MONTHLY RECORD

EUROPE

Supposed Glacial Cirques in the Middle Vosges.

WHILST traces of former glacial action are fairly plentiful in the Southern Vosges, they are extremely scarce in the middle section of the range—a fact which lends interest to a description of various cirque-like forms in the latter section by Otto Jessen in the *Zeitschrift für Gletscherkunde* (Band xi. Heft 3, March 1920). They occur in the "Buntsandstein" region south of the Donon, on the east and north-east slopes of La Max, Le Rond Pertuis, and the Bipierre, and consist of more or less circular niches which break the regularity of the slopes, and greatly resemble ancient cirques. All are very similar, and occur on or near the same geological horizon, viz. the junction of the Vosges Sandstone with the underlying Upper "Rotliegendes" (marked otherwise by the number of springs there issuing). They are placed high up above the valley floors, and are bounded on the upper side by the steep cliffs characteristic of glacial cirques, while on the lower side they are blocked by moraine-like walls of rock fragments. The floor is level and consists of peaty soil, which has evidently taken the place of a former small lake. The basins appear to be of the shape of a shallow cup, but whether they are actually excavated in the rock has not been ascertained. Their origin seems only explicable as due to glacial

agency, and this conclusion is strengthened by their occurrence only on the cool exposure of the range. Other traces of glacial action are wanting, but this may be explained by the easily weathered nature of the rock. The cirques would seem to date from the last phase of the Ice Age, when the ice had shrunk to the extent of a few hanging glaciers, which would naturally be formed in indentations in the mountain-sides, such as occur elsewhere at the junction of the two geological formations named. Though confined to a zone between 620 and 670 metres above the sea, they can hardly give a clue to the former snow-level, as they were probably of local occurrence only, where the conditions were specially favourable. These forms are closely comparable with the much more numerous cirques in the Black Forest, which are also most frequent on the east side. The writer ends with a sensible suggestion that the use of the term "cirque" (Kar of the German-speaking Alps, etc.) should be permitted to include features of similar outward form, even when the mode of formation is not identical. These cirque-like hollows of the Vosges and Black Forest are rather to be ascribed to the removal of detritus by the ice than to any excavating action, which some have sought to make a criterion of a true cirque.

AFRICA

Commandant Audoin's Journey from the Cameroon to Egypt.

Commandant Audoin has long been known to geographers for his hydrographical surveys in French Equatorial Africa and the Lake Chad region. During the war he took part in the military operations in the Cameroon (where he was wounded), and was afterwards charged with inquiries into the possibilities of opening communications between the coast and the French Chad territory through the newly acquired territory of the Cameroon. Last year he returned to Paris after completing an interesting traverse of the whole width of the continent to the Nile and Egypt, passing *en route* some of the least-known districts south of Darfur. Some notes on his journey appear in *La Géographie* for September–October 1920, being concerned chiefly with a discussion of the present economic position in the regions traversed. The journey from Garua on the Benue to Egypt occupied six months, and was made without military escort—an indication of the satisfactory state of security now prevailing in regions only quite lately brought under European influence. After briefly considering the value of the Cameroon territory acquired by France (the northern, Sudanese, portion is particularly favourable for cattle-rearing), the note discusses the possibilities of using a route through the Cameroon for the supply of the Chad region and Wadai. At present it will be necessary still to depend upon the Niger and Benue as a means of access from the sea, though it is hoped to become independent of this alien route in time. For the moment the chief need is the establishment of a French line of steamers on the Benue and the construction of a railway from Garua to the Logone, which will connect the basins of the Niger and Shari, and make of Garua to some extent the maritime port of French Central Africa. In time something may be done to extend the Cameroon railways and improve the system of roads, since the rivers are practically useless for navigation. The notes on the country south of Darfur give useful information on a tract partially known from the explorations of M. A. Chevalier, but lately so harassed by the raids of the Sultans of Darfur, Dar Kuti, and Dar Sila as to be in great part depopulated. Since the establishment, in November 1918, of the French post at Birao, Dar Kara has begun to recover through the influx of people from Darfur, but Dar Kreish (Krej) and

Dar Binga are still without inhabitants. What has been known as Lake Mamun is a vast swampy depression with small patches of water all the year round, and a few villages on spots not covered by the inundations. The country situated between the Mamun and the first dunes of south-west Darfur is inundated in the rains, but in the dry season a waterless desert from which the elephants are forced to migrate southwards. North-east of Dar Kara is Dar Taasha, fairly well peopled by half-sedentary Arabs and rich in cattle. It seems to be mainly on the French side of the boundary (formed south of 11° N. by the Nile–Congo and Nile–Shari water-parting), for Commandant Audoin found that a temporary watercourse, the Toal—a tributary of the Yata and through it of the Shari—cuts 11° N. near the 24th meridian east of Greenwich, thus carrying the Shari basin further east than has been supposed. [The Toal, or Toyal, is shown by report on the Sudan Survey Department map on the scale of 1/250,000, published at Khartoum in 1920, as flowing much as is described by the French traveller, but cutting the 11th parallel somewhat west of the 24th meridian.] The further route led to El Obeid by way of Abu Gabra, one of the lately established British posts in the south of Darfur.

Progress in the Belgian Congo.

The Belgian Minister for the Colonies, in introducing the budget for the Belgian Congo for 1920, spoke at some length of the present economic position in the Colony and its prospects for the future, with special reference to the development of means of communication. An extract from his speech, forwarded by the British Ambassador in Brussels, has been obligingly sent us by the Department of Overseas Trade. The Minister, M. Franck, indulged in an enthusiastic eulogy of the riches of the Belgian colony, which he considers the jewel of Tropical Africa, possessing not only untold mineral and vegetable resources, but an unrivalled system of fluvial transport. He regretted that the development of its resources was left by Belgians more than need be to foreigners. Besides the exploitation of copper, tin, and iron at Katanga, and of gold at Kilo and Mobo, diamonds have been found in the Kasai and Kwango region, and ten thousand workmen are now being employed in their extraction. Attempts are being made to educate the natives to take an active part in their own administration. Referring to the transport question M. Franck said that at present the roads were not good, but it is proposed to improve them after the model of the British East African possessions. Tonnage for river transport is not yet sufficient for the amount of merchandise, but progress has lately been made through the enterprise of the National Society of River Transport. The railway system (which, in conjunction with the river navigation, supplies communication with the Upper Congo, Rhodesia, and other parts of South Africa, and with the east coast *viâ* Ujiji and Tabora) is also being extended. The most important line—that from Matadi to Leopoldville—is still inadequate to meet the requirements, though its capacity has been increased by the supply of new rolling stock. A new line has however been traced between the terminal points, which will have the advantage over the existing line in its avoidance of steep gradients and sharp curves. Four mail steamers now run between Antwerp and Matadi, and four cargo boats have lately been purchased.

AMERICA

The Northern Appalachian Coalfield.

In 1912 the United States produced something over one-third and Great Britain something over one-fifth of the World's output of coal. If we take as

unit 100 million short tons, the United States' share was 5 units, and of these $3\frac{1}{2}$ came from one great coalfield, and $2\frac{1}{2}$ from a single State in that field—Pennsylvania. With these striking facts Mr. P. W. Bryan begins an instructive article on "Some Geographical Factors in the Northern Appalachian Coalfield" in the *Scottish Geographical Magazine* for 15 October 1920. They are sufficient to show the importance of the Pennsylvanian coal to the world's economy at a time when the British coal industry is passing through the most critical stage in its history. Mr. Bryan shows a full understanding of the geographical factors at work in Pennsylvania as well as of the statistics of recent production, and he gives a well-digested summary, bringing out the whole position at a glance. The Appalachian coalfield forms a great belt from Pennsylvania to Alabama, lying to the west of the Allegheny Front by which the westward-sloping plateau falls abruptly eastward to the "Great Appalachian Valley" (in reality a complex of parallel ridges and furrows). Structurally the plateau consists of a series of low broad synclines and anticlines, while the ridges and furrows to the east are the result of intense folding and crushing of the strata against the old continent of Appalachia. After being worn down by erosion the plateau was uplifted, with the result that the rivers dug out deep trenches which to-day play an important part in the industrial development of the region. The rocks are mainly massive sandstones and limestones of Carboniferous age containing several coal-seams, of which the most important is the famous Pittsburg bed. The shallow synclines have preserved the coal at no great distance from the surface, while the low anticlines bring it still nearer the surface, and where their summits have been planed off it outcrops on either flank. The main producing area in Pennsylvania lies east and south of Pittsburg, but the coalfield extends westward into Ohio and southward into West Virginia. Pittsburg owes its importance to its position as the focus on which various river valleys (of the Allegheny–Ohio system) converge from the south-east, giving a down-grade for all coal moving north-west. Thanks to the cutting down of the river valleys the mines are strung out in long lines along the streams. The coal lies nearly horizontally over large areas and is of very uniform thickness, making possible the use of coal-cutting machinery on a large scale. Rather more than half the coal is obtained from "drifts" driven in from the river-bank by an up-slope so that it can be run by gravity to the water-side: when obtained from a down-slope mechanical power is needed to raise it. Vertical shafts are also in use, but the depth is so moderate as to greatly reduce the cost of raising as compared with that entailed by the deep shafts of this country. The old terraces in which the rivers are now entrenched provide excellent sites for mining communities, and facilitate the use of the valleys for railway routes. The coal is of a high-grade type, and the coke from the Connesville district is the standard blast-furnace fuel of the United States. Besides being used locally for the Pittsburg iron industries, it is sent to other parts in large quantities, though of late there has been a tendency for the coal to be sent away as such, to be made into coke where required. Mr. Bryan discusses the effect of geography on the transport routes to the north and east, those in the latter direction being governed by the breaches made by the rivers in the ridges of the Great Valley. Those from the Pittsburg district connect with the northern tide-water ports—New York, Philadelphia, and Baltimore, while the West Virginia fields are linked with Newport News and Norfolk. As against all the above advantages, the only important disadvantage from which the United States suffers from the point of view of export is the distance of her coalfields from tide-water.

Swedish Explorations in the South American Cordilleras.

A Swedish scientific commission under the leadership of Professor Otto Nordenskjöld, and with Mr. A. Bäckman, geographer, and Count S. de Rosen, zoologist, as its other members, left Sweden in June 1920 with the special aim of studying some little-known regions in the Central and Southern Cordilleras. In Peru the Government immediately put ample means at the disposal of the expedition, and appointed a commission under the leadership of Dr. Carlos Rospigliosi Vigil, director of the Natural History Museum in Lima, and well known for former explorations in the Peruvian forest region, to co-operate with the Swedish scientists. During the months August to October this expedition studied more especially the glacial features of the Sierra region south of Oroya, and then, in rafts navigated by Indians of the Campa tribe, descended the river Perene, which has never before been explored scientifically, to its junction with the Ene, returning by the Pangoa valley, also very little known. Here fossils were found in several places ; and the studies of the structure and topography of the eastern forest-clad slopes of the Cordillera, as well as of the ethnology of the Indians, will be of interest. From Peru the Swedish party, which was now joined by Captain N. H. Pallin, proceeded to the south of Chile. Here the Government put a small steamer at its disposal for the voyage, and with this the members were at the middle of December on their way to the Peñas Gulf, their principal object being to study the region round the well-known San Rafael Lake, and if possible to ascend by one of the glaciers to the inner mountain region and to study the extensive so-called inland ice, which has never before been visited in this its northern part. The commission expects to return to Europe at the end of the southern summer.

AUSTRALASIA AND OCEANIC ISLANDS

Limestone Resources of New Zealand.

Fertile as is the greater part of New Zealand, this fertility can only be maintained by the judicious use of fertilizers, of which lime is perhaps the most generally important. An elaborate study of the resources of the Dominion from this point of view, as well as the almost equally needed phosphate resources, has been made under the auspices of the New Zealand Geological Survey, and the results as regards lime have been published in *Bulletin* No. 22 (N.S.) of the Survey, the author being the Director, Mr. P. G. Morgan. The Memoir begins with a chapter summarizing the uses and importance of limestone and lime, the methods of exploitation and transport, mode of occurrence, and so on, from a general point of view, with no special reference to New Zealand. The two other chapters deal respectively with the North Island, and the South Island and dependencies, taking each separate county in order, and discussing for each the limestone resources (if any) and the transport facilities, including those for import of lime from outside where no local resources are available. The writer makes no attempt to summarize the conditions for New Zealand as a whole ; possibly this will be done in the second part of the Memoir. There are two large-scale maps showing the limestone localities. Few of the counties are without some resources, though their extent and character differ greatly, as do the transport facilities for introducing supplies from outside. Of Whangarei County in the North Island, we read that "not only has it numerous deposits of high-grade stone suitable for calcination, but it has immense quantities of argillaceous limestone suitable for application to the soil after pulverization, and eminently adapted for the manufacture of cement. Many of the deposits

are close to a railway or to deep water. . . ." Waitomo County "is well provided with limestone of the highest grade." In Collingwood County (South Island) "there are enormous quantities of high-grade stone, suitable for agricultural purposes, for building, and for use as a flux for the iron-ore south of Parapara Inlet . . . Pure magnesian limestone and dolomite occur in unknown amount north-west of Collingwood." Tertiary limestone seems to be unlimited in quantity, but is not as a rule high-grade. Unfortunately the mountainous nature of the county impedes internal communications, but Golden Bay may be regarded as potentially a good port. Waitaki County, again, "contains great quantities of high-grade limestone, favourably situated for being worked." These are examples of counties with good resources, but there are others with little or no supply and badly situated for obtaining lime from elsewhere. The monograph gives details throughout of the geological features and references to previous literature.

The Climate of the Falkland Islands and South Georgia.

In *Geophysical Memoir* No. 15, of the Meteorological Office, we have a discussion by Mr. C. E. P. Brooks of the "Climate and Weather of the Falkland Islands and South Georgia," chiefly on the basis of some ten years' observations between 1905 and 1915. The Falkland Islands in climate and scenery much resemble some of the outer isles of Scotland, like the Orkneys and Shetlands, and indeed are populated mainly by shepherds of Scottish origin. As the Falkland group is bathed by cold ocean drift instead of warm, the mean annual temperature is about 7° lower than that of the south of England in a roughly corresponding latitude, and about 2° lower than that of the Orkneys or Shetlands, which lie 10° farther from the equator, and have a similar damp and cheerless climate. At Cape Pembroke the ten years' record indicates a mean temperature of only 42·9° F., ranging between 36·7° in July and 49·3° in January, the corresponding figures for London (interchanging January and July) being 49·6°, 38·8°, and 62·7°, which show that the Falklands are much colder in summer but only a little colder in winter. At Stanley the average annual rainfall is about the same as London's, 25 inches; but it is pointed out that the amount must be much greater on the exposed western coasts, and among the highlands of the interior. South Georgia lies somewhat farther south, and is highly mountainous with peaks up to 8000 feet, so that there conditions are more decidedly "sub-arctic," with large glaciers and a permanent snow-line on the western side as low as 2000 feet. On the north-east side föhn winds to a large extent prevent accumulations of snow. At Grytviken, South Georgia, the mean temperature is lowest (27·9°) in July and highest (43·5°) in February, and the annual precipitation amounts to about 56 inches. The climate of the Falkland Islands is not unhealthy, but the almost constant high winds are very trying, especially as they prevent the sunshine of summer from ever producing anything approaching a hot day, the temperature barely exceeding 60° F. on some four days in the year. The number of days with frost and snow in the Falkland group (without South Georgia) is rather large. It would seem that the climate of the Falklands in their isolation from great land masses is even more monotonous than that of the Scottish islands, which owe their greater variety to proximity to larger land-areas. The statistics quoted for the frequency of gales in Falkland are interesting in that they do not show that marked concentration of storms into mid-winter which is such a striking climatic feature of the North Atlantic.

POLAR REGIONS

Mr. Cope's Journey to the Antarctic.

In the *Journal* for April last we published the statement that this Society was unable to approve of the plans or the leadership of Mr. J. L. Cope, or to give his proposed expedition to the Antarctic its countenance and support. Nevertheless there have been during the last few months some references in the newspapers, especially American, to the "British Imperial Antarctic Expedition," as having the support of the Society. Other and more numerous accounts refer to the Polar Research Institute and the University of Cambridge as the sponsors of the expedition.

A typical newspaper story is that of the *New York Evening Post* of 11 December 1920, from which the following extracts are taken:

"Perhaps the largest exploring expedition now on its way, certainly the largest of its kind ever organized in England, and the one from which the greatest results are expected, is the British Imperial Antarctic Expedition, under the leadership of Commander John Lachlan Cope, F.R.G.S., formerly of the Royal Navy, who accompanied the last Shackleton expedition as surgeon and biologist to the Ross Sea Party.

"Dr. Cope plans to circumnavigate the Antarctic continent, and to spend five years in the work. . . .

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Cope's Fleet of Ships.

"His ship, the *Thor I.*, sailed from England on September 28 last, and from Norfolk, Va., where Dr. Cope joined her, on December 26. She was to touch at Montevideo and then go to Deception Island in the Falklands, where moving pictures will be made of the whaling industry. Late in October a second ship left Cardiff, Wales, for the Falkland Islands. Three whalers of 7000 tons each and one whale catcher of 200 tons will accompany the expedition.

"Associated with Dr. Cope on the expedition are N. G. Lester, navigator; Thomas W. Bagshowe, geologist; Captain George H. Wilkins, chief of scientific staff (he accompanied the Stefansson expedition in the same capacity); and 120 men.

* * * * * * *

"The total cost of this expedition is estimated at about $750,000. It has the backing of the Royal Geographical Society and other British scientific bodies, besides that of the Imperial Government and the Governments of Australia and New Zealand."

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The facts underlying the above are that Mr. Cope and members of his small party have been given by Mr. Lars Christensen a passage to the South Shetlands in ships of the Norwegian whaling company. They were to be joined in Montevideo by Captain Wilkins, and expected whalers to land them somewhere about Hope Bay in order that they might make a journey down the western coast of the Weddell Sea.

In view of possibilities it is desirable to repeat for public information that this self-styled "British Imperial Antarctic Expedition" of a few men is not in any way whatever approved or supported by the Royal Geographical Society, nor by the Polar Research Institute, nor the University of Cambridge. The party owe much to the liberality of the Norwegian whalers, and particularly to Mr. Lars Christensen, and it is due to him that the enterprise should be viewed in its proper perspective.

GENERAL

The Oil Palm as a Plantation Crop.

The latest issue (1920, No. 2) of the *Bulletin of the Imperial Institute* contains an interesting article on the African Oil Palm, its uses and cultivation.

As is well known, the industry maintained by the products of the oil palm is one of the most important in West Africa, particularly Nigeria, where such products form a large proportion of the exports. They consist both in the oil obtained from the fleshy pulp which surrounds the nuts (used in Europe very largely for the manufacture of soap and candles), and in the kernels themselves, the oil of which is largely employed for making margarine. Hitherto this industry has depended on the produce of palms growing wild in the West African forests, but trials have of late been made in the cultivation of the tree in plantations. Success has already been obtained in Sumatra and other parts of the Malay region, and it is expected that the oil palm will become a plantation crop of great importance in the Eastern tropics. It is considered that so cultivated it may yield larger profits than the coco-nut palm.

Erratum: Mount Everest Discussion.

In the report of Mr. Freshfield's speech, p. 17, line 5 from bottom, for *ice* read *air:* the mis-report made the speaker refer to the "erosive action by water and ice," which not only contradicted the first part of the sentence on "glacial protection," but was opposed to the whole sense of the argument.

Erratum: Spelling of Geographical Names.

An accident which occurred in printing the January *Journal* illustrates one of the difficulties confronting the P.C.G.N. When passed for press the table of the R.G.S. II. system contained three vowels with the diæresis; early in the course of printing two of the three, the *o* and the *u*, lost the two dots from above them, and the table became badly wrong. Such accidents must often defeat the best intentions, until British printers can complete their founts by the addition of letters with the diacritical signs properly cast.

MEETINGS: ROYAL GEOGRAPHICAL SOCIETY: SESSION 1920–1921

Fourth Evening Meeting, 20 December 1920.—The President in the Chair.

Elections.—Gordon Hooper Brown; Harry Cox; Colonel K. S. Dunsterville, C.B., I.A.; Harold B. Foster; Lady Goold-Adams; Captain Harry Jones; The Rev. Duncan R. Mackenzie; Colonel C. S. Meeres, C.B.E., R.A.; Captain E. C. Mogridge; Miss B. Ommanney; Captain John Monkhouse Orwin; Major George Meredith Sanderson, M.R.C.S.; Frederick Lumley White; Allan Wilen; Major Hubert Francis Wilson, M.C.

Paper: The Future of Polar Research. Mr. Frank Debenham.

Fifth Evening Meeting, 10 January 1921.—The President in the Chair.

Elections.—Mrs. Thomas Alexander Baggs; Thomas Richard Byers; P. Betton Done; The Rev. William Haddow, B.A.; The Ven. Archdeacon Leonard Rhys Hancock; Edgar Chignell Harwood; Prince Charles Hopkins; Motoichi Ikegami; Robert Henry Kinvig; Teisaburo Kuga; Bernard Lockey; Patrick William Mactavish; Edward Geoffrey Payne; Charles James Perkins; Lieut. C. W. Seymour-Hall; Bernard Siffken, B.A.; Kusuo Tida; Captain H. H. Wilkinson, M.A.; George Wishart.

Paper: A Reconnaissance in the Caspian Provinces of Persia. Captain J. B. L. Noel.

Third Afternoon Meeting, 17 January 1921.—The President in the Chair.

Paper: International Aeronautical Maps. Lieut.-Colonel E. F. W. Lees.

The Geographical Journal

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FROM BAGHDAD TO THE CASPIAN IN 1918

Major-General L. C. Dunsterville, C.B.

Read at the Meeting of the Society, 6 *December* 1920.

THE circumstances that led me to Persia in 1918 are probably now well known, though at the time it was necessary to observe strict secrecy in the matter for obvious reasons. It may be as well, however, to briefly recapitulate here the events that led to the despatch of my mission through Persia with a view of reaching Tiflis, the capital of Georgia, in the South Caucasus.

Up to the outbreak of the Russian revolution in February 1917 the Russian troops in North-West Persia linked up with the right flank of our Mesopotamian army in the neighbourhood of Khanaqin, which lies on the frontier between Western Persia and Mesopotamia. The allied line was therefore unbroken from Baghdad through Persia and the Caucasus to the Russian front in Europe.

The revolutionary authorities, in the simple belief that war could be stopped by one side declining to fight, ordered all Russian troops in the field to withdraw and leave the front open to the enemy. This action left our right flank in the air, and opened a direct route for Turkish troops and German agents and spies into Central Asia, where they hoped by creating an atmosphere of revolt and disturbance to threaten our position in India.

Obviously something had to be done. It was impossible at that critical period of the war to spare troops from any of the fronts, so it was decided to send a mission composed of selected officers and N.C.O.'s to Tiflis. At Tiflis they were to reorganize the local troops and reform the line against the Turks. In Persia the line might be held by volunteers from the Russian revolutionary troops who had not yet evacuated the country. It was thought that when the local troops in the southern Caucasus saw their own homes threatened with invasion they would gladly take up arms again at the call of any of the Allies who would undertake the task of restoring order and reorganizing the various units. The venture might have met with success, but it was never put to the test, as the mission failed to reach Tiflis and was obliged instead to confine

its attention to holding the line from North-West Persia as far as the Caspian Sea.

I received my orders in Peshawur on Christmas Eve 1917, and on 18 January 1918 arrived at Baghdad, accompanied only by my A.D.C., Captain Dunning. The members of my force were being selected from all the fronts, mostly from among the Dominion troops, and it took them a very long time to reach my headquarters. It was impossible to wait for any large body of them, so as soon as I had got together a party of twelve officers—on January 27—I determined to set out and see for myself what difficulties awaited us on the road, and whether any of them would prove insuperable. There were difficulties of bad roads, the probability of bad weather, the hostility of the Kurds, the hostile neutrality of Persia, the Russian revolutionary soldiers, and finally the declared opposition of Kuchik Khan and the Bolshevik Committee at Enzali, our port of embarkation in the Caspian. I was quite hopeful as regards the first five factors, but doubtful as to the last two.

Kuchik Khan is the revolutionary leader of the Jangalis, who are the inhabitants of the forest-clad province of Gilan lying between the watershed of the Elburz Mountains and the southern shore of the Caspian, through whose territory the last 60 miles of our road passed. He is an honest reformer whose war-cry is the very legitimate one of "Persia for the Persians." He was in command of some 5000 well-armed men, trained by Austrian and Turkish officers, and amply supplied with ammunition by the Turks. He had stated definitely that he would not allow us to come down the road, and surely it would be no very difficult task for him with his 5000 men to eat up our little party of twelve officers and two clerks with one armoured car.

We started off in the light Ford vans of which so much use has been made in this war, and after many vicissitudes and difficulties with snowdrifts on the mountain passes, we left Kazvin on 16 February 1918 to put Kuchik Khan's words to the test. After staying that night at Manjil we left for Enzali on February 16, and passing by many threatening warriors on the road reached the port at sunset.

Here we found ourselves out of the frying-pan into the fire. The town contained about 2000 Russian revolutionary soldiers, and was controlled by a combined committee of Bolsheviks and Jangalis. The Russian soldiers did not appear particularly hostile, though a demonstration was made outside our quarters which was certainly not a friendly one, but the Town Committee were very determined to thwart our progress, and our efforts to procure shipping for the further journey were quite unavailing owing to the fact of the Committee having placed an armed guard on each ship.

After a stay of three days, during which the attitude of the Committee became more and more threatening, I decided to withdraw and try the forlorn hope of running the gauntlet once more through Kuchik Khan's

country. To my intense surprise the Jangali troops on the road allowed us to go by without firing a shot, and I was able to withdraw my party to Hamadan and there take stock of the situation with a view to another attempt to reach the Caucasus. The opportunity for that only came at last in August, and ended in the fall of Baku, which town we evacuated on September 14 and withdrew to Persia.

I was thus compelled to pass the whole summer in Persia, but so far from being idle we were as busy at other important tasks as we would have been with our ordinary task if we had succeeded in reaching Tiflis. My duties brought me much into contact with the Persians, and gave me some insight into their character, but leisure for serious geographical consideration of the country was entirely lacking, and such observations as we made were made solely from the point of view of the military situation.

The portion of North-West Persia in which my force operated may be roughly described as a triangle formed by joining together Khanaqin on the Mesopotamian frontier, Tabriz, and Tehran, the sides of the triangle being 260, 310, and 370 miles. The Persian plateau, approached from the Baghdad side through low foothills, rises abruptly at the Taq-i-Gireh pass 150 miles from Baghdad, and falls again to the Caspian Sea on the northern slope of the Elburz range at Manjil, 550 miles from Baghdad. The intervening space of 400 miles by road, 300 miles in a straight line, offers an unvarying landscape of alternate barren mountain ranges and fertile valleys. With the exception of the hills between Taq-i-Gireh and Kirmanshah, where a few dwarf oaks are to be seen, none have trees or even bushes on their slopes, the cause of their barrenness being not unfavourable climatic conditions so much as the absence of effective forest laws. In the spring, after the melting of the snow, the hills display a varied flora, which includes several beautiful species of tulip and iris. These mountains, which form part of what are rather loosely called the Zagros group for want of a better term, are connected with the mountains of Asia Minor, and run in parallel lines from north-west to south-east, with the exception of the Elburz range, which runs more nearly east and west. The Elburz range to the north of Tehran, forming the southern boundary of the Caspian Sea and separating Persia from Russian Trans-Caspia, constitutes a link between the mountains of Asia Minor and the Hindu Kush and Himalayas in the north of India.

The north-western portion in which we operated has a bright dry summer with no need for the Indian punkah, while the winter is severe and snowfall heavy. The rainfall is so small as to be of practically no account in agriculture, which depends almost entirely on the small rivers of melting snow, which provide sufficient water for the crops of the cultivated valleys.

During winter the many passes that lie on the road between Khanaqin and the Caspian are all blocked with snow, and we encountered great

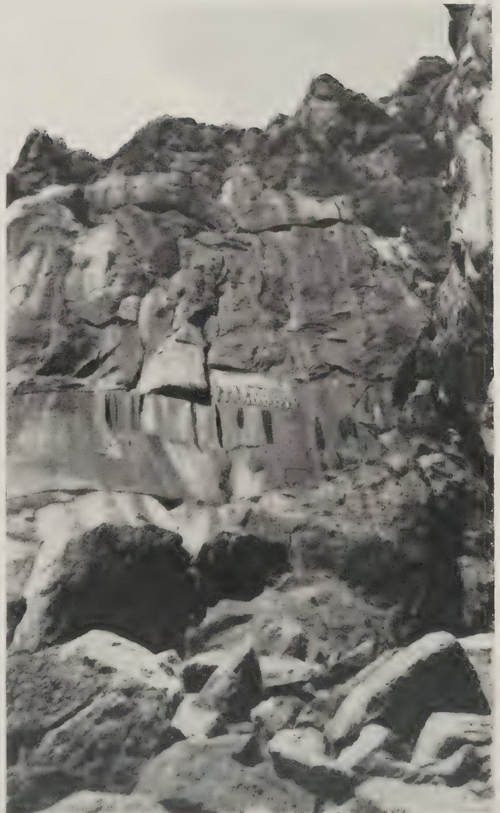
difficulty with our cars. It took us more than a week to cut through snowdrifts from 6 to 12 feet deep on the Asadabad pass and haul the cars over with ropes.

With the exception of the drainage of the Tabriz area and the northern slopes of the Elburz, all the rivers of this region lose themselves in the great salt desert which forms the centre of Persia. The Safid Rud, which breaks through a gap in the Elburz mountains at Manjil, drains the country in the neighbourhood of Tabriz and flows into the Caspian Sea near Enzali. The other rivers are small and unimportant, and are mostly fordable except when swollen with snow water in the spring. With the exception of the main road by which we travelled, and which I will describe in detail, and the road from Kazvin to Tabriz, most of the routes are mere tracks suitable only for pack-animals, but sometimes passable for wheels for considerable distances in fine weather.

On leaving Baghdad the road runs almost due east over the clay soil of Mesopotamia, which gives a good surface for pneumatic tyres in fine weather, but becomes practically impassable in the rain. Khanaqin on the Persian frontier is 94 miles from Baghdad, and here the low hills are entered. Here also we passed the last date palm, emblem of Mesopotamia, and at Paitak, 56 miles further on, camped for the night at the foot of the Taq-i-Gireh pass. On the next day we were able to progress 3 miles only. The first mile of the road is cut out of the rock and ascends at a very steep gradient, necessitating our pushing each car up by hand. A blinding snowstorm coming on prevented any further progress, and continuing for several days compelled us to seek shelter in a ruined sarai at Surkhadisa. On February 9 the snowfall ceased, and we succeeded in reaching Karind and thence Harunabad, 191 miles from Baghdad. It was only possible to get over the pass by starting several hours before dawn and crossing the snow while it was still frozen hard, but it was not an easy task. The hills as far as Karind are covered with a dwarf deciduous oak, which furnishes both firewood and food for the inhabitants of the few villages. The acorns are very large and form a valuable food in times of famine. After descending from the pass the road runs through cultivated land, and here our difficulties were even greater than on the mountain-side. In the latter case, however bad the road may be, it must be clearly defined, but on the level, when the smaller landmarks are covered by a mantle of snow, it is often impossible to guess where the road is; we did a good deal of unintentional cross-country work, and found that the soft mud in the melting snow was a much worse obstacle than rocks and boulders on the mountain road. On February 3 we arrived at Kirmanshah, 230 miles from Baghdad, having passed safely through the Kurd country without encountering any opposition. The Kurds in this neighbourhood have the reputation of being particularly truculent, and the Russians suffered many casualties from their raids, but the snow that hampered us so much had probably damped their ardour and sent them down to the lower hills.

SKETCH-MAP OF WESTERN PERSIA, TO ILLUSTRATE GENERAL DUNSTERVILLE'S ROUTE FROM BAGHDAD TO THE CASPIAN

BISITUN VILLAGE, FROM THE INSCRIBED ROCKS


THE INSCRIPTIONS AT BISITUN


A STREET IN SULTANABAD, 100 MILES SOUTH OF HAMADAN

Between Harunabad and Kirmanshah we crossed the Mahi-dasht plain by a great stroke of good luck in fine weather. The name, which means Fish-plain, suggests that it is normally not far removed from a swamp, and in bad weather it is impossible for wheeled vehicles to cross.

From Kirmanshah the road runs at the foot of high hills as far as Bisitun. Here are the wonderful rock inscriptions of Darius which we had no leisure to enjoy, but during a halt for repairs some good photographs were secured. The negatives from which my pictures are made were taken by Captain M. S. Aldham, who, being in charge of the repairs to our cars, formed a perpetual rearguard to the column. He was able to use his frequent enforced delays for photography, and I must acknowledge my indebtedness to him for the loan of his negatives.

From Bisitun to Sahneh, 38 miles from Kirmanshah, the road wanders indefinitely through cultivation and marshy ground. A bridge over a tributary of the Kara Su near Bisitun gave us some trouble. It was a fine solid single-arch brick structure, but the Turks had only just failed to demolish it in their retreat. The greater part of the arch had been destroyed, but just enough remained to run the cars over on with a few inches to spare. From Sahneh to Kangavar, 56 miles from Kirmanshah, the road is rough and stony, and we had considerable difficulty in getting the cars over the Sahneh pass, 6750 feet high. Starting at 4 a.m. it took us twelve hours to cover the 56 miles, and we were glad to be hospitably entertained to a hot meal by a Russian detachment at Kangavar. Leaving Kangavar, we reached Asadabad, 78 miles from Kirmanshah, at 9 p.m., a very tiring day for the drivers. The road lies mostly over flat ground and is not demarcated, which resulted in the cars getting into difficulties in the dark, and we should probably have failed to reach our destination had we not been fortunate enough to secure the services of Lieut. Georgiev of the Russian detachment at Kangavar as a guide. At Asadabad we came in for a spell of very bad weather. The snow began to fall soon after we had got the cars settled into the courtyard of the sarai, and all movement was impossible on the following day; it was not till a week later that we were able to cut through the heavy snowdrifts on the pass, 7600 feet high, and haul the cars over with ropes, reaching Hamadan, 333 miles from Baghdad, on February 11, having taken sixteen days over the trip. Up to Asadabad the road was, as I have described, little more than a track. From Asadabad to Hamadan the road on the pass is steep but well graded, having been recently improved by the Russians for military purposes. From Hamadan to Kazvin and thence east to Tehran and west to Enzali the road is properly constructed and well metalled, being in the charge of the Russian Road Company. I believe that the portion from Khanaqin to Asadabad has since been regularly made by skilled labour from Mesopotamia, and is easily passable by motor car.

From Hamadan the road runs across undulating fertile country, following the course of the Kara Chai river, which is twice crossed by

good bridges. At 60 miles from Hamadan the foot of the Sultan Bulaq pass is reached. The top of the pass is 7500 feet and the road was blocked with snowdrifts, but as we had now got in touch with the retreating Russians the deep drifts offered no difficulty, the troops working their hardest to keep the roads clear in their anxiety to get home. At Abi Garm hot sulphur springs are passed, and at Nahvand, 108 miles from Hamadan, the road emerges from the mountains and runs straight across the plain to Kazvin, which is reached at the 145th mile.

The road through the pass as far as Nahvand winds through a narrow defile, and these 30 miles would constitute a serious obstacle to an army advancing in face of opposition.

From Kazvin the road to Manjil, 71 miles, presents no difficulties with the exception of the Bikandi pass, which is only 5000 feet high, but is frequently blocked with snow; from the top of the pass to Manjil the road is of the usual mountain type, calling for no particular remark. The real change occurs at Manjil, and from here the 50 miles to the sea almost baffle description. For about a mile and a half the road winds downwards with an easy gradient to the big stone and iron girder bridge over the Safid Rud, which here makes its way through a narrow gap in the hills. After crossing the bridge the road, which is cut out of the solid rock, turns due north, following the course of the river on its left bank. The Safid Rud is impassable at all times of the year, and in the spring and early summer is a raging torrent. One has the sensation here that Asia has been left behind, and the scenery and flora are distinctly reminiscent of Europe. At Nagober, about 20 miles from Manjil, the road plunges into thick forest with dense undergrowth, which only ceases in the vicinity of Resht at the 40th mile, where the semi-tropical nature of the country, now almost at sea-level, is marked by the ricefields and plantains growing in the open. From Resht to Enzali the road runs through cultivation until the sand-dunes that betoken the proximity of the Caspian Sea are reached.

I have already described the circumstances under which we first traversed this road and our fortunate withdrawal from Enzali. On the return journey to Hamadan we had difficulties with snow in the passes, but we arrived there without loss on February 25. The performances of the cars had been very creditable; they had run a distance of about 900 miles in a month, the time involved being no fault of theirs, for I doubt if any other car would have got through at all. On the return journey it took us six hours on the top of the Sultan Bulaq pass to travel 6 miles, owing to the fact that on the steepest gradient the snow had thawed and then refrozen, leaving a surface like glass.

My headquarters remained at Hamadan until June 1, when I moved to Kazvin. During these three months I received several parties of my own force and a few troops in addition, which just sufficed to make some little display with a view to concealing our weakness.

The most trying period was the month of March before the arrival of any addition to our numbers. It was hard to make the twelve officers and two clerks look like an army, but the kindly Persian habit of exaggeration helped us a great deal. And we were not entirely unsupported, as we had entered into an arrangement with Colonel Bicherakov, commanding a body of Cossack " partisans," for our mutual benefit. The main body of the Russian army had withdrawn from Persia, but Bicherakov's men, who remained personally loyal to him, still retained their discipline and were not at all a negligible factor. We had much during this time to keep us busy. We were engaged in thwarting the plans, and sometimes capturing the persons, of enemy agents; roads had to be constructed and supplies collected in view of a possible movement of troops in this direction. Calls had to be exchanged with Persian officials and landowners. A good intelligence system had to be worked up and a terrible famine dealt with.

As soon as my second party arrived we set to work raising Persian levies and safeguarding the roads, and we were soon able to push small detachments further afield towards the Turkish line to act as a screen from their observation and to give them a false idea of our numbers. In this way we occupied Senna, Bijar, and Zinjan, while Major Wagstaff from the latter town was able to send out parties to within a few miles of Tabriz.

At the end of March Kuchik Khan threatened a move on Kazvin. As that town was full of his sympathizers he would probably have succeeded in establishing himself there without bloodshed, and such a famous exploit would have brought all waverers to his standard. From Kazvin nothing could prevent him from making a similar move in the direction of Tehran, where the people would have welcomed him with open arms. Once in possession of the capital he would be in a position to bring about a state of revolution throughout Persia, which would have thus become an open field for the spread of Bolshevism.

This move was checked by Bicherakov, who marched his cossacks into Kazvin on March 26. Kuchik Khan thereupon halted at Manjil, taking up a position in trenches covering the bridge, and stating that the road was henceforth closed to all traffic and any movement in his direction would mean a declaration of war.

My efforts to have a personal interview with Kuchik Khan were thwarted by his foreign advisers, who feared that we might settle matters without fighting, which was exactly what they did not want. I managed, however, to send Colonel Stokes down with a flag of truce, but he was not given a free hand and no agreement was reached. Hostilities therefore became unavoidable.

I have not time here to refer to the achievements of the force under General Sir Percy Sykes which was operating in Central Persia, nor were the two forces ever able to communicate with each other, but obviously

the success or failure of either reacted on the other. Sir Percy Sykes' force was invested at Shiraz from May 24 to July 6, and had he failed to bring matters to a successful issue, my small party would have been swept away.

On June 12 a mixed force of cossacks, with one squadron of the 14th Hussars under Captain Pope and two armoured cars, attacked the Jangalis' position at Manjil and entirely routed them, thus once more clearing the road to the Caspian. But though the enemy were off the road they remained concealed in the neighbourhood in the dense forest and continued to give us much trouble until August, when, after Kuchik Khan had again been severely defeated by a British detachment under Colonel Matthews at Resht, terms of peace were drawn up and the road was finally cleared. Within the last few days I see that the old state of affairs is again revived, with just the difference that Kuchik Khan's men are now openly spoken of as Bolsheviks, and the unfortunate town of Resht is alternately taken and retaken every few days by the Red Army—another name for the Jangalis—and the Persian cossacks. It would have been possible to settle the Gilan trouble finally in 1919 if it had not been for the provocation and help rendered to Kuchik Khan by the Baku Mohammedans, whose heads were completely turned by our recognition of Baku as the seat of government of the new independent Mohammedan state of the Azerbaijan Republic.

On June 26 I went to Enzali to see how affairs stood there, and found the Revolutionary Committee still obstructive but in a rather chastened mood. They were at least gracious enough to come and see me in my quarters instead of, as on our first visit, sending me peremptory orders to attend their committee meetings. I managed to make a good bargain for petrol with them, and that was all I got out of it; but it was a good deal, and meant not only a plentiful supply of petrol but an improvement of sixty per cent. in the price.

I also visited H.B.M.'s Minister Sir Charles Marling at Tehran, to post myself in details of policy. The road to Tehran may be briefly described. The distance is about 90 miles, and the direction from Kazvin almost due east. There are no important gradients on the road, which runs along at the foot of the southern slopes of the Elburz range. At Karij, 20 miles from Tehran, the Karij river is crossed by a good bridge. This is one of the many rivers of this region that lose themselves in the salt marshes between Tehran and Kashan.

Bicherakov had in the mean time crossed with his troops to Baku and was in command of the Red Army, having thrown in his lot with the Bolsheviks in a last hope of keeping the Turks out of Baku. He found the Red troops quite useless, and in the end was obliged to withdraw to the north, with the result that we never met again until I had the pleasure of finding him in London in the spring of this year.

Towards the end of July the Bolshevik *régime* at Baku came to an

end, and the reins of government were taken over by a body calling themselves the Central Caspian Dictatorship. The seven Dictators were capable, earnest, and well-meaning young men, but the mere fact of there being seven of them militated against their chances of success. Their rule was undoubtedly preferable to that of the Bolsheviks, but they did not possess the strength of character necessary to conduct the affairs of government in such trying circumstances, and although they issued sound orders with regard to the defence of the town, they proved quite incapable of seeing that their orders were carried out.

The long-expected demand for help in the defence of Baku against the Caucasus-Islam army reached me about July 28, and I at once sent over Colonels Keyworth and Stokes with the few troops available, promising to reinforce as rapidly as possible. In the end we succeeded in getting over No. 8 Battery R.F.A. and the greater part of the 39th Infantry Brigade under Colonel Faviell. Severe fighting continued throughout August, and heavy casualties in the Brigade were solely due to the continued failure of the local Baku troops to reinforce the point of danger. Under the circumstances the further attempt to defend the town would have resulted merely in further loss of life, and success was not to be hoped for. The British troops were therefore withdrawn on September 14 and returned to Persia, where the force was broken up.

My headquarters were on one of the Caspian steamers named the *President Kruger* except for a short period when I took up a billet in the town. I took this step to reassure the townspeople, who started a rumour that the British general kept on board ship with a view of deserting the Baku people in case of trouble!

There was that much truth in the rumour, that I knew the evacuation was bound to take place sooner or later unless the town troops developed the fighting spirit they entirely lacked, and that if I did not hold on to my three ships I should never be able to get the Brigade away when the town was taken.

The distance by sea from Enzali to Baku is about 180 miles, and the voyage takes eighteen hours. While I knew the fact that the Caspian Sea was the largest of inland seas, I must admit that I had never realized its enormous size. Although 80 feet below sea-level the water is very slightly salt, and in the northern basin it is fresh enough to be drinkable. The reason why a lake which receives such an enormous inflow of water should remain below sea-level with a tendency to fall still lower is explained by evaporation; but I question that explanation. The total volume of water brought in by the rivers is enormous; the Volga alone drains an area of over half a million square miles, and yet the shrinkage is supposed to be accounted for by evaporation only. The Black Sea with approximately an equal surface receives less water, and while continuously discharging through the Dardanelles, remains above sea-level, yet there is no reason to suppose that the conditions for evaporation

in the Caspian area differ sufficiently from those of the Black Sea area to account for the anomaly.

On our arrival at Baku in August it was evident that the call for help had come too late to give us a fair chance of success. Still, given the bad morale and lack of enterprise of the enemy, the situation was not hopeless if the town troops could be called on for a normal display of courage. In that they entirely failed, and Baku in consequence had to fall. The enemy's strength was probably from 12,000 to 15,000; I could put 900 British rifles into the firing line, the town troops might provide another 6000, and our artillery was about equal. The line of defence was about 20 miles long, of which distance 8 miles might be considered as denied to the enemy by natural obstacles of cliffs and salt marshes. But the worst of the situation was that in the earlier fighting, when the choice of a defensive position was still in the hands of the Baku army, a bad selection was made and the Turks were allowed to occupy a position from which the entire harbour and every portion of the town were within range of their artillery fire.

With a population of 80,000 Tatars in the town, natural sympathizers with the enemy, it was obvious that the latter should be well served in the matter of intelligence, and there is no doubt that the accuracy of their shell fire could only be accounted for by some method of signalling from the town. Owing to the position of the town at the bottom of a cup, direct observation was not possible for the Turks, yet their shelling was always direct on the object. My ship alongside of the wharf came in for her share, but though hits were obtained on the wharf itself, she always escaped. Our headquarters in the town was blown to pieces, and when transferred elsewhere the artillery fire was at once turned on to the new site.

Baku lies on the south coast of the Apsheron peninsula, 26 miles from its extremity, and at a point where the width of the peninsula is about 13 miles. The peninsula points due east into the Caspian Sea, so as we faced the Turks attacking from the west, we had a triangle with sides of about 26 miles on a base of 13 miles behind us. The entire region is arid, and there are no trees or shrubs and scarcely any vegetation of any sort. There are about twenty villages in the triangle, and those on the north coast possess some fertile land. It will be understood how complicated our situation was when I explain that before our arrival in Baku the Turks had worked round the right flank and were in occupation of most of these villages.

Baku lies in a hollow. The ground rises from the water's edge to the semicircular line of cliffs that surround it at about 3 miles from the harbour. The top of the cliffs is about 500 feet above sea-level. Between these cliffs and the Turkish position a narrow valley runs north and south The railway from Batum approaches Baku from the south-west, and passing northwards through this valley curves round to the east and enters the town from the north. This brief description will show what a strong

position the town troops held. Although commanded from tbe enemy's position, it was so difficult for attacking infantry to cross the open valley and scale the cliffs that had the Baku men shown any grit at all its capture by an attack from the west would have been impossible.

Throughout August the fighting continued, with the unvarying result that on each occasion of serious attack the British detachment in the portion of the line attacked, denied the support that alone would have rendered its position tenable, fell to the enemy. Under these circumstances it was impossible to demand of the men a continuance of these pointless sacrifices, and on September 1 I made up my mind to withdraw and leave the town to its fate.

I accordingly invited the Dictators and the various revolutionary committees to meet me on that date at 4 p.m. and listen to what I had to say on the situation. When the committees had assembled I put the case clearly to them in very few words. I laid stress on the futility of prolonging a defence where the town troops never held their ground when attacked, and where all movements of such troops during an engagement were direct to the rear. It would be farcical if it were not tragical. I owed certain responsibilities to the British troops under my command, and could not consent to a further sacrifice of their lives. I proposed, therefore, to withdraw my detachment the same evening, and I had called the committees together in order to give them fair warning and to enable them to take whatever steps they thought fit in the circumstances. My words were greeted with murmurs of disapproval and resentment, and I was informed that any movement of my ships with troops on board would be the signal for the revolutionary gunboats to open fire on them. After an hour's discussion I withdrew, leaving the committees to decide on some line of action. But revolutionary committees never decide anything, and the rest of the afternoon and evening were spent in passing resolution after resolution and accomplishing nothing.

I felt that to withdraw my troops in the dark leaving gaps in the line at all the most critical points would not be fair on the helpless community, and I decided therefore to postpone the withdrawal for the time being.

We actually remained another fortnight, hoping against hope that my warning words might put some life into the defence, and at least give them the courage of despair, but no great improvement was effected, and it was evident that the town must fall as soon as the Caucasus-Islam army delivered a really serious attack on a large scale. The long-expected attack was launched by the Turks two hours before daybreak on September 14, and by dawn they were already in possession of the heights above the town. The British detachments fought nobly against great odds and kept the enemy from entering the town up till sunset, when he was too exhausted to pursue his advantage further, and under cover of darkness our troops withdrew in good order to the ships, all being on board by 10 p.m.

It is not maintained that the British fought the battle alone: some of the local units displayed a tardy bravery, and there were many individual cases of heroism; but the spirit of "do or die" which alone could save Baku was generally lacking in the larger units, and an endeavour to collect troops for counter-attack resulted in failure owing to their reluctance to move towards the danger point.

Our movements through the town had been fortunately unobserved, and it was not until I had got the last man on board that a breathless dictator arrived with a message from the government that the British troops were at once to resume their positions in the line, and that the gunboats had received orders to fire on us if we made any move. I replied that I had nothing to add to my previous remarks, and that my troops had borne the brunt of seventeen hours' fighting without relief and with insufficient support; their return to the front line was a physical impossibility.

I had already succeeded in getting away two ships, the *Kursk* and the *Abo*, with all sick and wounded on board. It now remained to run the gauntlet with the *President Kruger.* We slipped noiselessly away from the wharf without lights about midnight, passing within 500 yards of the guardship, which ordered us to stop and opened fire on our refusal. The first shell went just over the bridge, causing the steersman to drop the wheel and disappear in the hold. Revolutionary soldiers and sailors have little enough courage in their own cause; I could hardly expect them to display any for me. The captain took the wheel, and steaming at full speed we were soon at a range that made shooting in the dark quite harmless. Behind me came Colonel Rawlinson in a little steamer, the *Armenian*, loaded with explosives. Why he was not sunk or blown up I do not know, but his little ship came through without loss of life after receiving six direct hits, fortunately all above water-line.

By the evening of September 15 the small force had reassembled at the Persian port of Enzali, and the expedition was at an end.

Though depressed by a sense of failure, we knew that, apart from our work in Persia, in keeping the Turks out of Baku for six weeks at that period of the war and denying him the use of the valuable oil, our efforts had not been in vain.

Before the paper the PRESIDENT said: As you know, General Dunsterville made that extraordinary expedition from Mesopotamia through western Persia to the Caspian Sea and Baku. He carried out a venturous and skilfully conducted expedition, and it is a great pleasure to welcome him here this evening. I am very sorry the hall is so over-full, but that is due to the popularity of the lecturer and the great interest of the paper.

General Dunsterville then read the paper printed above, and a discussion followed.

The PRESIDENT: We have heard of the expedition Sir Percy Sykes made in South Persia, and the lecturer has referred to the fact that what he did was

MAHIDASHT, NEAR KIRMANSHAH

THE SUMMIT ABOVE MAHIDASHT, LOOKING NORTH-EAST

BETWEEN KAZVIN AND MANJIL

MANJIL

ON THE ROAD NEAR MANJIL

of the greatest possible use to him. We shall be very glad if Sir Percy Sykes will speak.

General Sir PERCY SYKES: We have heard a most interesting lecture to-night, but in reality it is a great deal more than that. I think that when the history of the Great War is finally written and we gain some distance from events, this will be looked upon as the great adventure of the Great War. I happened to be at Delhi on a visit from my own command in Southern Persia, and I was introduced to Dunsterville and confidentially informed of his mission. We spent several hours together, and I told him all I could about the country, and said that he was on the biggest gamble I had ever heard of. I do not think any one can fully understand from what he has said the immense difficulties he had to overcome, and I do not think there are many Englishmen who could have done what he did. He has a very strong personality and also an extraordinary command of Russian, not to mention a very strong sense of humour. These are very valuable qualifications. The first dash to Enzali was almost a mad thing to do, and I imagine it was done because Dunsterville realized that it was an absolute gamble, and that after all he might possibly get to Enzali and see if he could not go on to Baku. I think that it is most remarkable that when General Dunsterville was coming back the Jangalis, with their fingers on their Mausers and all having two bombs (they never had less than two bombs), never attacked him. It was an extraordinary piece of luck, and so was the second and more successful advance, when he reached Baku. If you think of it, his ship was run by a Soviet crew who did what they liked, and yet with them he took an expedition to Baku, and denied the oil of Baku to the Turks for six weeks. He also did what was of still greater importance, he prevented the Turks and their German masters from joining hands with the thousands of Austrian and German prisoners in Central Asia. I was in Central Asia in 1915, and saw thousands of those Austrian prisoners who were more or less allowed loose by the Russians, and had all these prisoners been armed there would have been an army of about 30,000 or 40,000 German and Austrian prisoners. They could easily have been reorganized, and this would have been a most appalling menace to the Indian Empire. Had the Turks come and found everything comfortable for them at Baku, there was nothing to prevent them at that time from crossing the Caspian and starting operations on the other side, because the Mensheviks who were there were very weak, although we had another mission which came up the east side of Persia to help them, and unless some such action had been taken, I think things would have been a great deal worse than they were. One other very interesting point is the hoisting of the White Ensign by Commodore Norris on the Caspian Sea. It brought back to my mind our first great English land explorer, Anthony Jenkinson. He was the first Englishman to travel down the Volga and sail upon the Caspian, and he wrote, "We sette uppe the redde crosse of S. George in our flagges," the flag of St. George being the forerunner of the White Ensign. Anthony Jenkinson was a great seaman and land explorer of the age of Queen Elizabeth, and I think we cannot make a better comparison of the feat of General Dunsterville than by comparing it with the great adventures of the spacious days of Queen Elizabeth.

Major POOLE: It is with great diffidence that I get up to speak, because I can only tell you a little about the Caucasus in uneventful times. I visited Asia Minor and the Caucasus about eleven years ago when on leave from the Egyptian Army, from Constantinople going along the Black Sea to the Caucasus; but a point that one would like to consider is the growth of the

three Republics, the Georgian Republic with its headquarters at Tiflis, the Armenian Republic with its headquarters at Erivan, and the Moslem Republic with its headquarters at Baku. These have now come into being on account of the great upheaval, and whether they will be eventually Bolshevized or fall under the influence of the Turks again will be a very interesting study. Who can say if they will be able to maintain their separate existence? Another point I would like to ask, and that is, General Dunsterville spoke of the Jangalis. In that varied mixture of races in the Caucasus, how does this name Jangali arise? Is it a name given to dwellers in particular forests, or the good old word from India applied to wild people? One would like to have that point cleared up.

General DUNSTERVILLE: I can answer the last question. It reminds us of the Indian word "Jungle," but they are not, however, jungley people. They are inhabitants of the Gilan province on the side of the Caspian, and having vowed to defend Persia to the last drop of their blood, they have given up social life and gone into the jungle.

The PRESIDENT: We in this society are always glad to hear a tale of great adventure, and we have heard this evening a tale of a most romantic kind. We are also glad to have the opportunity of hearing such a tale from a man like General Dunsterville, who has to a remarkable degree the capacity for dealing with Orientals. General Dunsterville is an officer of the Indian Army, and he evidently acquired there the knack and capacity for dealing with all kinds of people. He has also what is of inestimable benefit, a sense of humour. There was only one slide that was missing, and I wish we had had it. I wish we had had a photograph of his Staff Officer smiling, because I know from personal experience what a great benefit it is to have an officer who will smile upon these critical occasions. I had such an officer—Colonel O'Connor—with me in Tibet, and the way he smiled on the Tibetans through all the vicissitudes of our mission was one of the great causes of its success. General Dunsterville has described to us the way in which he led this wonderful mission from Mesopotamia, right through Persia to Baku, and although we in this country had very imperfect information while the war was on of what our men were doing in distant parts of the world, we had gathered this much, that a peculiarly adventurous mission had been undertaken by General Dunsterville, and it has been a great privilege to us to welcome him here this evening and hear the account of it from his own lips. You will, I am sure, all join with me in a very hearty vote of thanks to General Dunsterville.

THE CONTROL OF CLIMATE BY LAKES

Prof. E. H. L. Schwarz

Read at the Afternoon Meeting of the Society, 15 *November* 1920.

I HAVE been advocating for some years past a project for the rewatering of the Kalahari. Many objections have been raised, and apart from the economic considerations the greatest stumbling-block has been the question whether the creation of a great lake in the centre of a continent is likely to be followed by beneficial effects on the surrounding country. The considerations involved have a much wider application

than to the Kalahari, for they affect every irrigation project in an arid region.

I have endeavoured also to show that in the case of Africa one of the chief causes for the drying up of large portions is the drawing away of water from the inland districts by the action of headstream erosion by the coastal streams.

In the conformation of Africa, the most outstanding feature is the existence of a block of elevated land with steep borders; hence there are rapid rivers on the sea-board and slow-flowing ones in the interior. The result is that, as the erosion of a river depends on its velocity, the coastal streams erode back into the territory of the placid inland ones, draw off the water, and leave the central portions of the continent arid.

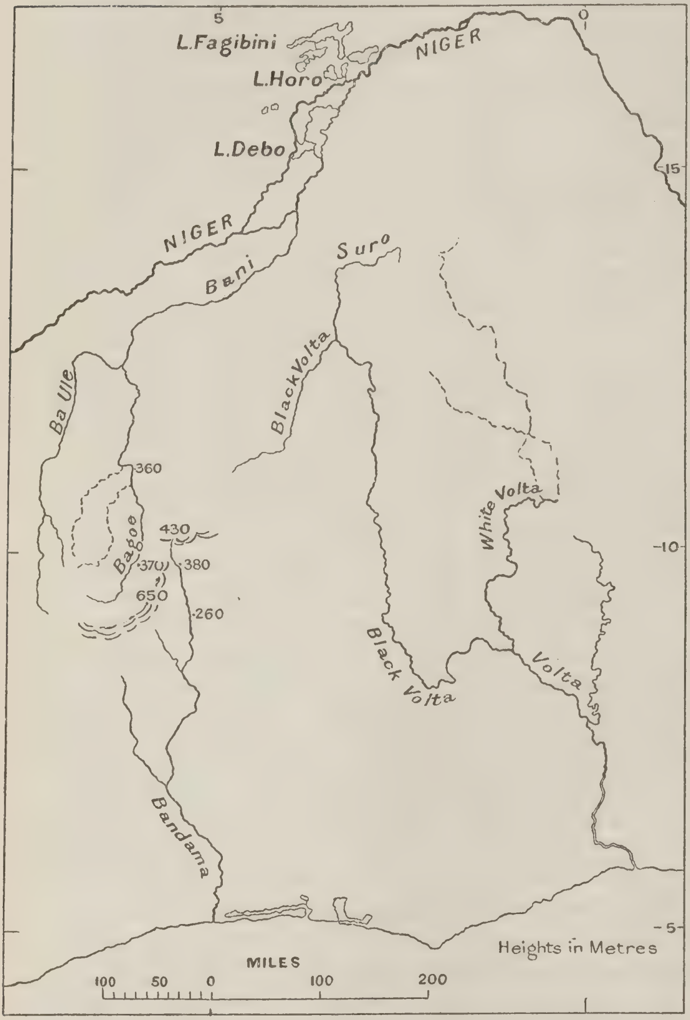
The most striking example of this action is afforded by the rivers of the West Coast. Attention was first drawn to these by R. de Lamothe.* The Black Volta rises in the hills on the West Coast and flows northwards; it then makes a sudden turn, comes southward, piercing the rampart of hills on which it rises, and eventually joins the White Volta. A small tributary in the bend extends in the direction of the Niger and indicates the channel by which originally the upper branches of the Black Volta reached the Niger. Kitson (*Geographical Journal*, November 1916, p. 374) has discussed the lower portion of the course of the Black Volta, where there is very marked evidence of recent displacement.

To the west there are two tributaries of the Niger, the Ba Ule and Bagoe, rising from the same coastal rampart. These flow north, unite, and continue in a low-grade river, the Bani, which flows parallel to the Niger for some distance, and eventually debouches into Lake Debo. On the coast side there is the Bandama river, whose tributaries have eaten back far north of the sources of the inland streams, and have captured a large part of the original territory of the Bagoe. The steep short course of the Bandama allows of great velocity for the stream, whereas the Bagoe is checked at Lake Debo, and its waters only reach the ocean by a long circuitous course down the Niger; the Bagoe cannot hold its own against the invading headstreams of the Bandama, and the result will be that at some future date the Bandama will tap the Bagoe, the shorter access to the sea will cause the drainage to be drawn southwards, and eventually the southerly gradient will reach the junction with the Ba Ule. When this occurs a river system similar to the Black Volta will arise, that is to say, the Bandama will unite the three original rivers and will rise on the inside of the coastal rampart, flow northwards, turn and pierce the same group of hills on which it rises, and thus find an outlet to the sea, so repeating the peculiarities of the Black Volta. The consequence will be that a very large volume of water will be taken from the Niger; a similar large volume of water has already been taken away by the capture

* "Contribution à l'étude geologique des territories du Haut Senegal-Niger," *Bull. Soc. Géol. France*, (4) 9, 1909, p. 528.

of the headstreams of the Volta, and hence one can estimate how greatly the main river has suffered and will suffer from this headstream erosion of the coastal streams.

That there has been a great decrease in the volume of the Niger is shown by the deposits of fresh-water lakes full of the shells of *Melania*, *Physis*, and *Planorbis* that extend to the west and north of Timbuktu; it is true there are shallow lakes, such as Fagibini and Horo, which still receive a certain amount of flood water, but they are insignificant in area compared with the former extent of the inundation. The plain stretching between Timbuktu and the Niger now is rarely flooded as it used to be. The whole district north of the bend of the Niger is full of evidence of a much greater flow in the main river, and one of the principal causes for the present deficiency is the conversion of areas of northward drainage, and consequently feeders of the Niger, into areas of drainage directed to the south and to the sea.



Rivers of the West Coast, showing capture of Niger tributaries

In the case of the Kunene, the river rises in the Angola highlands, descends to the northern end of the Amboland plain, the most perfect peneplain in existence, passes through the coastal rampart by a series of cataracts and waterfalls, the biggest having a drop of 300 feet, and

then finds its way to the sea through a precipitous gorge. The cataracts mark the place where the coastal river has recently tapped the inland drainage. Before it reaches the cataracts, the river has built itself up above the plain so that at flood-time the water escapes on either side through gaps in the banks. On the north there is a series of flood-lakes called billabongs in Australia, but on the south the water finds its way down the shallow spill-ways through the western half of Amboland. The flood fills all the low-lying portions of the country and brings with it innumerable frogs and barbel, which are caught in basket nets by the

Sketch-map of the Kalahari Desert and Amboland

natives. Water-lilies spring up as by magic, and the roots are eagerly sought after for food. Flood-time is therefore a season for rejoicing, and as the waters subside the crops which are planted on myriads of little hillocks come on rapidly, the forest is full of life, and the whole country is, as Galton in 1850 described it, "glorious."

I must explain that the whole country is forest, but there are natural clearings in it which are inhabited by various tribes quite distinct, and each with a separate chief, but all belonging to the Ovambo nation.

Owing to the wearing away of the cataracts, the river has lowered its bed and the area of the floods has steadily decreased. The eastern

portion of the country is abandoned to Bushmen, but the country is of the same nature as that on the western side, and there is evidence that the Okavango used to flood this portion as the Kunene does the other, and as it still does in the territory north of the Angola border.

It is proposed to build a masonry dam 40 feet high across the Kunene above the cataracts, when all the water will be turned into the spill-ways leading out of it southwards; the whole western portion of the country will then be flooded, and as the water subsides in the sandy soil, the trees will bring it up again and keep a constant moisture cloud over this area. Surplus water will find its way to the Etosha Pan, now dry. Here there is a well-marked lake-terrace 25 feet above the floor, on which stands the fort of Namutoni. The water will find its way far up the Ovambo river, and also up an uncharted river-bed which apparently connects with the Lion river, one of the spill-ways of the Okavango. Whether the water will find its way eventually into the Okavango cannot be decided until a levelling survey is carried from the Etosha to the Okavango. My own impression of the physiography of the country is that when the water in the Etosha rises to 20 feet there will be a through connection to the Okavango. The evaporation from the western portion of Amboland will increase the rainfall on the Angola highlands, the flow of the Okavango will be increased, and the flooding of the eastern portion will follow.

The practical question to be settled is whether by re-watering this immense tract any beneficial effect will accrue to the adjoining territory. Further, if the water of the Okavango and Chobe rivers is headed back by a weir on the latter river near the junction with the Zambezi and the water led along its former channels southwards to the great depression, the Makarikari, will this impounding of water that now finds its way to the sea have any marked effect on the country surrounding it?

The Etosha and Makarikari, if filled with water 10 feet deep, will hold $5{\cdot}5 \times 10^{12}$ cubic feet of water.

I have estimated the annual flow of the

Okavango	$1{\cdot}4 \times 10^{12}$ cubic feet
Chobe	·7 " "
Kunene	·4 " "
	2·5

The water will therefore be sufficient to put only less than something like 5 feet of water in the two lakes, and as the evaporation is quite 8 feet, they will dry up. Will this water remain in the country and result in increased precipitation, so that next year there will flow into the lakes 2·5 units of new water, and an appreciable quantity of water returned to it from last year's supply?

Adverse evidence is afforded by inland lakes like the Caspian, where there are extensive deserts in the north, by lake Chad, lake Rudolf, and

the Great Salt Lake of Utah, all of which are receding; and there is the instance of the Red Sea and Persian Gulf, with deserts on either side.

In the case of the Caspian, the deserts of Astrakhan are below sea-level; water evaporated from the lake is carried some distance by the wind and on rising to the higher ground tends to drop some of its moisture, leaving the intervening low ground dry. On the wind changing, the moisture-laden winds come from off higher to lower ground. The air suffers compression and its temperature rises at the same time; both higher pressure and temperature combine to raise the holding power of the air for water-vapour, and again no rain falls.

In the case of Chad and lake Rudolf—and the same conditions obtain in the Great Salt Lake of Utah—the area around, deficient in moisture, is so vast that all the water evaporated goes but a very little way towards increasing the humidity of the air. Colonel Tilho has brought back evidence that lake Chad formerly occupied an area comparable with that of the Caspian. A large portion of the drainage into lake Chad has been cut off by the boring headstreams of the Benue, and every year these, having higher gradients than the tributaries feeding the Chad rivers, are claiming more and more territory. If evaporation from the water surface in lake Chad is sufficient to give half an inch of rain in the Sahara, this has no appreciable effect on the country; were the area ten times as great as it apparently was formerly, five inches of rain would make a distinct change in the country, and in addition, the air being moist while the evaporation was proceeding, rain-laden clouds blowing in from outside would be reinforced, and additional rain would be secured in that way. M. Foureau in the 'Mission Saharien Foureau-Lamy,' gives descriptions of thunderstorms in the Chad area in which not a drop of rain reaches the ground, although the clouds can be seen discharging rain into the upper air.

Lake Rudolf is fed by rivers rising in hills to the north. The lake is receding, not because the evaporation is not discharging its quota of water-vapour into the air, but because the receding of lake Chad and an increasing aridity in other parts of the country are forcing the air over the continent to claim more and more of the moisture derived from the lake. The internal circulatory system was formerly sufficient to keep a constant level in the lake, but this is no longer the case.

In humid regions there may be a negative result over lakes, because the transpiration from meadow grass is greater than the evaporation from a free water-surface, in large part owing to the very large surface exposed by the blades of grass compared with the single plane surface of the pond or lake. The actual measured amounts of transpiration are in the proportion of 3 to 2, taking the maxima:

Evaporation from free water surface	144·8	Kg. per square metre per month
Transpiration from meadow grass	218	
,, ,, Oats (growing)	147	
,, ,, Oak trees (Summer) ...	28	

It follows that in a normally humid country, such as England or the Eastern States of America, a lake area may be one of less humidity and consequent rainfall than the grass lands around. This is the case in the great lake region of North America. In the "Meteorological Chart of the Great Lakes," by Alfred J. Henry and Norman B. Conger, U.S. Weather Bureau, 1907, the average loss in precipitation over the greater portion of the region is from 2 to 3 inches. In the 1899 summary in the same publication, the question of the relationship of evaporation to rainfall is discussed, and taking mean values the rainfall was 30·8 inches and evaporation 31·5 inches for that year, values which are sufficiently close. This case is the clearest one on record showing how local conditions influence rainfall. In nearly all other cases quoted in meteorological treatises, the area examined is too small or the data are too unsatisfactory to give results that are sufficiently definite, with the result that no clear statement has yet been given as to whether forests and lake surfaces do or do not influence climate. Walker, in the 'Report of the Indian Weather Service' for 1910, shows a correspondence between the rainfall of India and the floods on the Nile, but it cannot be established that the one is an effect of the other.

In the case of the deserts of Arabia, although the peninsula is surrounded by warm seas on three sides, the amount of moisture blown in from the coast is not sufficient to cause saturation and consequent rainfall. Assuming that the evaporation is the same as that at Aswan, 160 inches, an amount of water-vapour would have to be blown in sufficient to provide 160 inches of rain before Arabia could become a normal country where evaporation balances rainfall, and such an amount could only occur in the monsoon area, with high mountains to cause precipitation. In other words, the deficiency of moisture is greater than can be met from external sources save in exceptional circumstances, and the remedy is to provide sources of atmospheric moisture in the country itself. This can be done by irrigation.

The increase in humidity due to irrigation has been measured, in the Union Observatory in Johannesburg, in terms of evaporation; the beneficial result of the watering of gardens, growth of trees, and so forth in the suburbs that have sprung up round the Observatory is apparent enough in the following table, and is more marked when contrasted with the evaporation statistics given by the outside mines, which still record figures of 90 inches and over. In other words, the irrigation has produced merely a local cloud of moisture.

EVAPORATION RECORDS, JOHANNESBURG OBSERVATORY.

1904	92·3 inches	1912	68·9 inches
1905	84·7 ,,	1913	69·7 ,,
1906	70·1 ,,	1914	61·0 ,,
1907	76·7 ,,	1915	55·6 ,,
1908	66·6 ,,	1916	61·8 ,,
1909	69·6 ,,	1917	54·0 ,,
1910	65·0 ,,	1918	51·6 ,,
1911	71·9 ,,		

Irrigation, however, is of no use to the country as a whole in this respect, if it is not large enough. The influence of the Aswan Dam on the rainfall and evaporation in Egypt has been nil. The dam was finished in 1909.

To make any permanent impression on the climate of the country the irrigated area must bear some reasonable proportion to the area of land deficient in moisture. In the case of the Kalahari project the whole area to be re-watered by turning the rivers back into their former channels is:

Amboland	70,000 square miles
Etosha Pan	5,000 ,, ,,
Makarikari	15,000 ,, ,,
	90,000

To this must be added various smaller lakes in the Ngami region and irrigated lands, and the whole constitutes one-tenth of the area deficient in moisture. The area lies at an elevation of from 3500 feet in the north to 2500 feet in the south, with higher ground all round. The Kalahari basin, in fact, constitutes an enclosed area like the Great Basin of North America. Evaporation within the basin results in precipitation on the surrounding hills, and if this can be increased to a notable extent by turning in the rivers on the north, it is to be expected that there will result a circulatory system within the basin by which the stock of moisture will be conserved and increased each year by influx from outside. When stable conditions have become established, the surplus moisture will spread beyond the limits of the Kalahari and produce greater humidity over the rest of South Africa.

The great lakes of Central Africa with their adjoining forests supply the atmosphere with moisture, so that the south-east winds from the Indian Ocean are reinforced; within the vapour cloud of the great lakes there is abundant rain. Without these central reservoirs the continent would experience similar conditions to those in Arabia.

In South Africa, over the greater portion of the Union, the evaporation is over 90 inches with rainfall from 30 inches and less. It is understating the case if one takes the evaporation as three times the rainfall on the average, and this condition may be said to obtain over 1,000,000 square miles. Mr. C. M. Stewart, Chief Meteorologist to the Union, has stated that to make the country secure from droughts, an additional 9 inches of rain is required over 240,000 square miles; if 90 inches of evaporation be the minimum index, this extra rain can only be procured by the re-watering of 24,000 square miles. Such a stupendous area is quite out of the reach of ordinary irrigation.

In a semi-arid region * the benefits to be derived from a large inland

* It would help considerably if the terms "humid," "semi-arid," and "arid" were expressed in ratios of rainfall to evaporation. It would overcome the difficulty of

lake are that when the winds blow inland from the sea, the atmosphere being reasonably humid will allow precipitation as soon as the seasonal barometric depressions occur. As it is at present in South Africa, the air is so dry over the continent that in the region of the summer rains the influx of moisture from the sea is not sufficient to produce saturation and consequent precipitation. At the end of the season moisture has accumulated and when the temperature falls big downpours frequently occur too late to be of use. The most valuable effect of lakes, therefore, in the interior of a continent, is to keep the atmosphere humid so that the rains can fall in due seasons and with fair average intensity instead of in cloud-bursts following periods of drought.

Before the paper the PRESIDENT said: I have very much pleasure in introducing to you Prof. Schwarz, who has for many years taken a keen interest in the subject on which he is to give us a lecture this afternoon. His is a novel idea, and I dare say there will be some here who do not entirely agree with it, but it is one which will be of very great use if it can be turned into practice: we are grateful to Prof. Schwarz for putting it before us, and I hope we shall have a thorough discussion of it afterwards.

Prof. Schwarz then read the paper printed above, and a discussion followed.

Colonel E. GOLD: I am afraid I have only general meteorological qualifications to speak on this scheme, and the Director of the Meteorological Office, who has had much more experience than myself of the conditions in tropical countries, both Egypt and India, is unable to be present, being weather-bound in the Shetland Islands. The region of which Prof. Schwarz has spoken this afternoon lies in the belt of high pressure which stretches from the Indian Ocean to the Atlantic. It is a region of high pressure, not of local character or varying character such as the anti-cyclone that covers Siberia in the winter and is replaced in the summer by an area of low pressure. This area persists all the year round with slight oscillations. The Kalahari lies in a region where the general wind current is easterly. No doubt there are many local variations, but on the whole the wind current in that district is easterly. It comes from the Indian Ocean. The natural result would be that on the surface it would be a moist wind. But in a great anti-cyclonic area of that description there is a settling down of the air from above and gradual outflow from below. As the air settles down from above it gets relatively drier and drier so that there is not the normal fair chance of rainfall from it, because it is being, so to speak, artificially dried, and any tendency to the formation of rainfall in that area must first overcome the natural drying tendency. There is little doubt, in my opinion, that the formation of a great lake in regions of that kind would produce some increase in the rainfall, but it is a very much more difficult question to estimate the amount of the increase. The calculation that was made quite recently of the amount of rainfall that would be produced over 50 miles of northern France by a wind current blowing down the North Sea for about

explaining why, for instance, Lincolnshire with a rainfall of 17 inches is more humid than Bloemfontein with 20 inches. I would suggest:

Humid, evaporation equal to or less than rainfall.
Semi-arid, evaporation two to eight times rainfall.
Arid, evaporation more than eight times rainfall.

600 miles gave it as a maximum possible amount of about half an inch for a wind blowing down continuously and steadily for twenty-four hours. It is an appreciable amount, and does indicate that the evaporation from a water surface following rules which have been experimentally verified would produce conditions under which rain would fall. But to get the rain out of the air one must have some arrangement by which it can be cooled after the water has evaporated into it. If the winds blowing over the proposed lakes are forced in the journey over mountains which rise 2000 or 3000 feet above the level of the lake, then there is the reasonable prospect of getting an appreciable amount of rain out of it. But to me one of the difficulties of this proposed scheme is the assumption that appears to be made that the whole of the water, or practically the whole of the water, which is evaporated from the lakes will fall in the area and be added to the water which normally does fall there. Evaporation from the lakes will naturally be most intense when the atmosphere is clear and very dry; that is, when the settling down of the anti-cyclone is going on most vigorously. That evaporation, starting with the air so dry, is hardly likely to produce any appreciable rainfall. When the conditions over the area are favourable for the production of rainfall, then evaporation will be going on more slowly, and the amount which is added to the rainfall that falls under the present conditions will naturally be less, so that although one does feel that Prof. Schwarz's scheme would result in an increased rainfall over the area considered, it does not, it seems to me, follow that it would produce such a large increase in rainfall as that which he hypothesizes. The subject which he has put before us appeals very much to meteorologists, because it does indicate how important it is to get accurate observations from such a region. The period for which observations are available is all too short, and the observations themselves are all too limited to enable a discussion such as this afternoon's to be carried on with the real data which are essential for the solution of the problem. There is only one other way, I think, in which it is possible that the scheme could produce such an amount of rainfall as appears necessary; it is just possible, although it does not appear to be really likely, that the formation of these lakes over very considerable areas would produce an appreciable modification in the general condition of the atmosphere in that region. Such a modification could, conceivably, alter the position of the anti-cyclones which govern very largely the climate there, and if that were done it would result in a very marked change in the climate; but it appears to me that it would need, instead of an area of 90,000 square miles, something like ten times as much to be turned into a lake to produce any such change in the general scheme of atmospheric circulation. I listened with great interest to Prof. Schwarz's very lucid account of his scheme, and saw the very interesting pictures which he put before us this afternoon. Whether we agree with his scheme or not, we congratulate him on having put it before us with so much lucidity.

Mr. F. E. KANTHACK: Prof. Schwarz's scheme is not new to me. He has put it before the people of South Africa during the last few years, and I was very glad to see he was bringing it before a body such as this, in the hope that we might get together a number of people who are best qualified to criticize it. I belong to one of those not in agreement with the scheme. What we have to remember is that this scheme, which is certainly most attractive to the people of a country chronically suffering from drought, has naturally appealed very much to the popular mind, and whilst Prof. Schwarz has not many supporters on the scientific side in South Africa, he has certainly got the ear of the farmers and the public generally, and I am hoping that we shall get more this afternoon than mere appreciation of having listened to an interesting lecture. I am by

profession an engineer, and the last fifteen years of my life have been spent all over South Africa—a country I know very well—and fortunately in June and July last I was chairman of the Boundary Commission charged with the delimitation of the boundary between Angola and what used to be German South-West Africa. In the course of our work there I spent between three and four weeks actually on the Kunene, over a section which, so far as we know, has never been described by anybody from the British side. It is a pity, I think, that when Prof. Schwarz visited Amboland some time ago, circumstances did not enable him to visit the Kunene, because until one has seen the river and the conditions of its flow, it is rather difficult to dogmatize about what it will and what it will not do. Time is short and I must confine myself to a section of this subject, and I will speak of that which more particularly affects me as an irrigation engineer, and regarding matters which I know from personal observation. Prof. Schwarz's idea is to create a lake of 90,000 square miles. We have just heard from the meteorologist who last spoke that a great deal larger area than that would be necessary to produce the effect Prof. Schwarz claims. I have no hesitation in saying there is no possibility of ever creating such a lake area with the water available, or likely to be available, from the Angola highlands.

The PRESIDENT: Not 90,000 square miles?

Mr. KANTHACK: Not 90,000—nowhere near it! In making up the 90,000 Prof. Schwarz allocates 70,000 to Amboland, which he wishes to flood entirely, and 5000 to Etosha Pan. I do not see how he arrives at 5000 for the latter, for it is an area of little more than 1200 square miles, and as he only proposes to put 10 feet of water in it, when flooded to that extent it would not materially increase. I have travelled very considerably on the Etosha Pan with the Surveyor-General for the Transvaal, and there is nothing very materially wrong with the German military maps. There is one thing I disagree with in the scheme Prof. Schwarz set forth. I think he tries to attribute too much to head-stream erosion. Any one who has travelled across the Kalahari and over the Amboland plain, and especially who has studied the soil conditions there, will realize that another factor which has helped materially towards the diversion of this water from the central basin elsewhere is the silting up process. The whole of that central basin, stretching right across the Kalahari into Amboland is now filled with a tremendous depth of silt. Prof. Schwarz has referred to General Berrangé crossing the Kalahari. I was associated with that enterprise, as I had to find water for them. We bored for water right across the Kalahari along the old bed of the Kuruman river. No water was found anywhere near the surface. The only place we found water was in the bed of a very ancient Kuruman river which was everywhere located about 200 to 250 feet below the present bed of the river. The whole of this 250 feet through which we drilled, apart from a buried spur of the Koranna Berg range, is entirely composed of silt and calcareous tufa. We found the same thing in Amboland. All the wells that have been sunk are through alluvium and calcareous tufa. The soil over Amboland is of a fine sandy nature, and the layers vary very considerably in character and thickness. The surface is exceedingly porous, and from the study I have made of a large number of water holes, it is clear that only the top 17 feet is capable of holding water. At that level a particularly impervious band of calcareous tufa is struck, and below this all the water disappears into the lower strata. The whole of Amboland is silted up to almost, figuratively speaking, a dead level. What I found there clearly marked along the Kunene river above Erichson's Drift was

that the silt deposited near the banks of the Kunene, especially on its left bank, is such that the river in flood is no longer capable of overflowing its banks to the extent which it did in former times. It must be remembered that whilst the Kunene is, in its lower regions above the cataract, very level, it cannot pile up its bed like other rivers do, because a certain equilibrium seems to have been arrived at owing to the draw of the rapids and falls below Erichson's Drift, so that any tendency for the river to raise its bed would eventually be rectified by increased velocity due to the draw of the rapids. Another reason why I think the erosion idea is being overdone is that above the first cataract, of which Prof. Schwarz showed a picture, the river is for many miles (about 60 kilometres) very flat. It is so flat that any further flattening of that river-bed is inconceivable, considering the amount of water which has to be discharged down that channel during the flood months. I have examined that river from Erichson's Drift down to Rua Kana most carefully, and at the first cataracts there are no signs of great erosion going on. It is possible that these rapids may be creeping back, but the erosion is more in a horizontal than a vertical direction. The great falls of Rua Kana—which, by the way, are 420 feet high—are nearly 30 miles below Erichson's Drift. There are three sets of rapids. The first, about 5 miles below Erichson's Drift, are the Kavale rapids, which account for a 37-feet drop over about 3 miles; then about 10 miles lower down, the Chimbombe rapids, 69 feet. From Chimbombe to Rua Kana there is a bed fall of 246 feet in about 16 miles. At Rua Kana there is a sheer drop of 410 feet. Prof. Schwarz does not seem to have managed to get a very good photograph of the great falls, and I have with me a very excellent set of the Kunene river from Erichson's Drift. The falls are truly magnificent even at the time we saw them—within a month of the minimum flow.

I wish now to make a few remarks on the supposition that Prof. Schwarz's scheme is theoretically feasible from a meteorological point of view. From a practical point of view, I maintain it is entirely impossible. We must, in this matter, get back to what has appeared in Prof. Schwarz's book on the subject and also in various articles which have appeared here and in South Africa, and I wish to devote some time to correcting certain erroneous statements which have been made. The Kunene, to begin with, is a river carrying a greater discharge than the Okavango. The Okavango has, in its course of 710 kilometres, a much flatter gradient than the Kunene, and generally its whole drainage area, shape, and everything tend to make it a river of far more uniform flow than the Kunene. The catchment area of the Kunene is nearly 35,000 square miles, and that of the Okavango 26,700 square miles, and over these catchments the rainfall varies from 1500 millimetres—59 inches—down to almost nothing on the lower Kunene. I have divided both catchment areas into zones according to their rainfall, and allowing a very liberal run-off for the different zones, and having due regard to the nature of their catchments, it appears that as a maximum we may expect 350,000 million cubic feet run-off from the Kunene, and 324,000 million feet from the Okavango. The difference is not very great, but these figures fall very far short of the run-off which is claimed by Prof. Schwarz to fulfil his requirements. Now, on the Kunene, fortunately, we have some observations which throw some light on the way it discharges this enormous mass of water. The Kunene in September has a very small discharge. When I was there last July, in the beginning of the month, during the ten days I was on the big falls, I repeatedly watched the discharge very closely. The river was falling rapidly then, and on July 4 I calculated it, as best I could, at three different places, and found the dis-

charge approximately 1000 cubic feet per second. Colonel Roma Machado, who was Chairman of the Portuguese Commission, has spent a considerable time on the Kunene River and taken observations, and found that in September the discharge is only about half that. From Colonel Machado and other Portuguese officers who have been in that particular part surveying for a good many years, I also learned a considerable amount about the flow of the river, and from that I constructed a table showing the mean monthly discharge which will give this total run-off. Now taking this into consideration, the bulk of the flood water comes down between December and April. To begin with, there are six practically dry months all over both catchments. Then comes a small rain in December, but the catchment is then dry and the run-off comparatively small. Then there is a lull in January, followed by the main rains in February and March, and with them come the big floods, so that practically the whole of this vast discharge on the Kunene is crammed into a few months, and whilst this flood season is on, speaking as an engineer, when one is dealing with 100,000 cubic feet per second, talking about weirs, more particularly temporary weirs, to divert the whole of that amount over a plain of 70,000 square miles is something of a tall order. At the point at which Prof. Schwarz wants to put his weir, I have no hesitation in saying no weir can be built. The nearest place is at the head of the Kavale rapids, 5 miles below Erichson's Drift, and in order to divert even 50 per cent. of the water of the Kunene over the plains would necessitate a weir of not less than 100 feet high. There is no gorge there. The river at that place, from bank to bank, is, I suppose, 2000 feet across, and when the height of a weir like that is taken into consideration, a work of colossal dimensions would result. Above these little rapids there is nothing but alluvium; there is no foundation, and it is entirely impossible to construct any sort of weir. Prof. Schwarz has quite ignored the question of how those great volumes of water are to travel over the dead flat plain. The water from the Kunene has been in the habit of spilling out anywhere for 100 kilometres and more north of Erichson's Drift. This vast country has become so flat and silted up that it is practically impossible to produce sufficient head to discharge such great volumes of flood water over about 250 or 300 miles down to Etosha Pan. The fact that comparatively small volumes get into the oshanas and reach as far as Ondongua proves nothing at all.

Considering the nature of the soil of Amboland, the amount of water which could possibly be made to reach the Etosha Pan now would be but a fraction of the amount which could be diverted. But even if it were possible to divert the whole of the flow of the Kunene right across the Amboland plain—that is, anything up to 300 miles—the Pan could only be filled to the depth of 3 feet. A 10-foot depth, such as Prof. Schwarz wants to put into the Pan, would require more than the entire Kunene run-off. Assuming that half the flow could be diverted, not more than 50,000 million cubic feet would ever reach the Pan owing to the want of sufficient head and the enormous absorption and evaporation on the route. That amount in the Pan means about 18 or 24 inches in depth, and that spread over 1200 square miles is not going to achieve very much in increasing the rainfall over the Angola highlands, and the idea that the whole of Amboland is going to be put under water is also erroneous, because, whilst it is true that these oshanas traverse the country in every direction, they are in the nature of ribbons running through the country, which is generally at a higher level. We are entirely relying on Amboland for labour requirements in South Africa, and I may say here incidentally that the official aims

are in the direction, not of creating an enormous swamp in Amboland, but of diverting the water from the Kunene, in agreement with the Portuguese, into some of these oshanas, and of establishing a rough system of irrigation. I do not know how Prof. Schwarz has arrived at the enormous diminution of rainfall. There are no records which would justify his conclusion. The records of rainfall in Amboland are of very short duration, and I think such as Prof. Schwarz has seen I have also seen, and there is no evidence of any great diminution of rainfall. It is an erratic rainfall, and what Amboland suffers from chiefly is not deficiency of rainfall, but erratic seasonal distribution. A rainfall of 14 inches will give an excellent crop, but in another year, by falling a little too early, the same rainfall will cause the crop to be an entire failure. Last year the crop was miserable because the rain fell too early. I hope some others present will continue this discussion.

Dr. J. W. Evans: What Prof. Schwarz has had to tell us this afternoon is of special interest in connection with the question of the supposed desiccation in different parts of the Earth's surface. Some believe that the whole Earth is slowly becoming desiccated. This seems hardly credible, and the general tendency of thoughtful people is to endeavour to understand what are the local circumstances which have, in particular cases, caused a distinct decrease in the rainfall and fertility of the country. Prof. Schwarz has brought forward a very plausible explanation of the desiccation which he has, I think, shown to have taken place in South Africa. It appears to be due to the general cutting down of the streams by which the country is traversed, though he lays special stress on river capture. It will be best illustrated by comparison with a country, with which I am familiar, where this process of desiccation has not occurred, that is to the region immediately to the north-east of the Andes in the Amazonian region of Bolivia. It is a country in many respects similar to that of South Africa. The prevalent winds are from the south-east, blowing from an ocean which is at a considerable distance. These winds are robbed of much of their moisture by the high ground in the neighbourhood of that ocean, and a certain amount is also precipitated when they approach the mountains to the west. But there is a difference between these two countries. In the American area the lowlands for a long distance are almost absolutely flat, and the rivers which are nearly level with them cannot carry away the whole of the rainfall, so that the country is inundated in the rainy season for a distance of 300 or 400 miles from the mountains to a depth of several feet. As a consequence of the evaporation which takes place, partly directly from the water surface and partly by means of vegetation, the south-easterly winds which blow across this flat region receive a renewed supply of moisture, and a copious downpour on the eastern slopes of the Andes follows. There is therefore a local circulation of moisture in the region to the east of the Andes. If the whole region were elevated for several hundred feet, as we have every reason to believe was the case in South Africa, the rivers would cut their way deeply down into the country which would be rapidly drained of its water, the moisture in the air would be diminished, and there would be a great decrease in the rainfall on the eastern slopes of the Andes. That, it seems to me, is exactly what has taken place in the Kalahari desert. The occurrence of calcareous tufa in the alluvial deposits points to the fact that there was a large amount of evaporation when the rivers used to overflow to a much greater extent than now. The question which has now to be solved is how far we can reverse the process. Can we put back the hands of the clock of time? A very high authority has told us that is absolutely impossible, that the general structure of the region forbids it.

My chief reason for hesitating to accept this is the fact that the reverse process has taken place within a comparatively short time. I quite appreciate the arguments brought forward against Prof. Schwarz's scheme, but I confess my sympathies are with the farmers and the mass of the people who hope to see it a dream that has come true.

Prof. SCHWARZ: Colonel Gold showed how there is a descending current of air over the region, with its constantly drying effect. That is what is happening, but surely that is the very reason why we want this big area of water, so that as the air comes down dry it can be reinforced by something on the surface of the country? It is out of the reach of moisture from the sea, and we want, if we are to have anything at all in South Africa, something to reinforce the moisture in the air. Colonel Gold said I stated all the water evaporated from the country would be returned to it, and he doubted it. Probably he has not read my book, in which I have gone very carefully into that question. Part of the moisture which comes from the lake may be blown out of the country, but the effect of having a permanent vapour cloud over this area means that vapour blown in from outside has a chance of being precipitated, which it has not now. Two-thirds of the moisture may be blown out of the area, but we shall get an increase from the outside regions, and balancing the two (as I know, through very carefully studying that particular point), I say that the balance is in favour of more than the actual amount lost being returned to the basin. Nowadays the air blows in from the sea charged with moisture sufficient to create rainfall if there is, say, 80 per cent. moisture. If there is only 75 per cent. moisture in the air, then the moisture blown in from the sea passes away. If you can add a little more moisture, then it will precipitate rain. With regard to Mr. Kanthack's remarks and his statement of figures as to how much water will come down the Kunene, the matter is in a very precarious state at the present time; my idea is to go back in the process of desiccation and not have these terrific floods. I have dealt with it carefully in this book which Mr. Kanthack has had for many months. I have shown how these floods are caused by the excessive dryness in the flood area. Rains come and the water tears down the hillsides, and there is a big flurry of water in the valley. If we have these lakes, it will take ten, fifteen, or twenty years to make their effect felt, then we shall have this moisture permanently in the air, and the vegetation will be vigorous all the year. The same amount of rainfall will fall on the area, but it will be caught up in the vegetation and soft earth, and instead of having these terrific floods there will be a more or less constant flow of the rivers. Mr. Kanthack's statement that I want to make a lake of 90,000 square miles is simply put up to knock it down. I go most carefully in my book into how I arrived at the area to be rewatered. Nature has within the last five years sent water in flood down these channels, and it is no use talking about silting up.

The PRESIDENT: In the last five years?

Prof. SCHWARZ: Yes, within the last five years; I should think within the last three years we could say the water has come down as shown you on the screen. The flood I showed you was in 1917. I am not an engineer, and I may be wrong in saying that the dam has to be 40 feet high at a particular place. I want to make what Nature is doing by herself permanent, and I am absolutely sure that it can be made permanent.

The PRESIDENT: I happen to have been near the Kalahari, although not in it, so I can well appreciate how anxious the farmers must be that a scheme of this sort should be carried through. But the criticisms which have been made show that there are extreme difficulties in the way. Nevertheless, we are glad

in this Society that we have had the opportunity of hearing this project discussed. It strikes me, at any rate, that if it cannot do much good, it will at any rate prevent things from getting much worse than at present. It is a horrible prospect to think of the sand-dunes encroaching into South Africa as they have done into Central Asia, where we have seen them encroaching upon what were formerly prosperous lands. It does not seem to have been so very long ago that water ran down these river beds in the Kalahari, and we hope that from the fuller data which may be collected, some possible scheme may be evolved by which those rivers may be made to flow again. Colonel Gold said we want much fuller observations and data upon which the project may be evolved, but anyhow we thank Prof. Schwarz for having given us a very interesting lecture this afternoon.

Mr. L. C. W. Bonacina contributes the following note to the discussion:

The first point to note is that the great evaporation from such expanses of water as are contemplated would, by increasing the humidity, mitigate the desiccating winds which cause half the trouble in South Africa. The increased humidity would in itself tend to rainfall; but to estimate whether it would materialize, one must review the major factors controlling the climate of this part of the world.

South Africa lies in the general wind-belt of the south-east Trade, and it is well known that in both hemispheres the Trade winds reduce more or less to desert all land which these belts dominate, except where, as in the east of South Africa itself, mountains obstruct the main air currents. The Trade winds produce no rainfall over the sea, where they blow regularly and steadily, promoting vigorous evaporation under sunny skies. But in many lands the "back" of the Trade system is broken by pronounced seasonal or "monsoonal" modifications connected with temperature contrasts between oceans and continents. Thus the greater part of South Africa is in summer affected by low barometric pressure associated with a seasonal rainfall, which may be regarded as a southward protuberance of the equatorial rainbelt (see monthly rainfall maps of Africa in Knox's 'Climate of Africa').

Now of all types of rainfall, convectional summer land rains are probably most easily intensified by *local* evaporation, provided the water surface is not so great as, by acting like a sea, to lower considerably the summer temperature, and so the rainfall which develops over sun-heated continents. In Prof. Schwarz's project much will depend upon whether he has made a good hit in the size of the proposed lakes. There is no reason to suppose that the water surface would be too small to be effective, or too large to defeat the object. From the climatological standpoint, I think that the formation of lakes in the Ngami region of the Kalahari would be quite worth trying for the amelioration of drought in South Africa.

The case of South Africa is not parallel with that of North Africa. In the south true deserts are limited to the west coast. In the northern Trade belt there is an enormous land-locked area favourable to more intense drought than in the south, and no reservoirs on any practicable scale would be likely to have much effect on the climate of the Sahara.

9 December 1920.

THE FUTURE OF POLAR EXPLORATION

Frank Debenham

Read at the Meeting of the Society, 20 *December* 1920.

NOW that the world is gradually settling down after the upheaval of the war, we naturally find ourselves reviewing past activities and planning new ones. In the case of polar exploration there is an added reason for such a review, since the war itself has brought into prominence two factors which are likely to be of great importance in the solution of the last great geographical problems that remain to us. The first is the advent of the long-distance flying machine, which has speedily reached a standard of efficiency that renders it available already for certain types of work in high latitudes. The second and more important factor is that the war has impressed on nations as on individuals the lesson that for the efficient investigation of any problem careful co-ordination of aims and close co-operation in action are essential. The invaluable experience gained during the war can be of the greatest use in renewed attempts to solve the problems of peace time.

If further excuse for the subject were needed it would be found in the extraordinary diversity of opinion as to the value of polar work. On the one hand there exists a small but happily a virile section of people who look upon the exploration of the polar regions as the most urgent of all geographical duties. With these men polar exploration bulks so large that it dwarfs all other ideals. The exaggeration of the polar idea too often tends to express itself in expeditions devoid alike of co-ordinated plans and of the means to carry out the exact scientific observations so necessary for anything other than the achievement of bare travelling records without permanent scientific value. On the other hand, the existence must be recognized of a considerable and influential body of opinion which is either indifferent to or directly opposed to polar exploration. This may be due in part to the idea that the poles themselves were the only worthy objects; in part to the opinion of the self-styled "practical" man that no commercial results are likely to arise from polar ventures. The fact remains that there are a large number of people who can see no good in risking money or life in expeditions.

Between these views there lies a mean which it is proposed to develop in this paper. It may be confessed that in the past the element of romance which is inseparable from polar exploration has been at once a help and a hindrance: a help in that it has attracted at the same time both financial support and the services of men with high ideals; a hindrance in that it has overshadowed the scientific side of exploration and has tended to alienate the interest of those who are proof against sentiment. My object is, therefore, to discuss the future of polar work

in the light of the really important problems that await solution, and to indicate if possible some of the methods of preparation and attack.

Let me begin with a reminder as to the distinction between the words "discovery" and "exploration." Discovery in the geographical sense will soon be a thing of the past, for we shall shortly know, at least in outline, the main geographical features in every part of the world. But exploration—the more detailed examination of unfrequented tracts—is likely to provide work for geographical pioneers for the next century or longer; a very comforting thought to societies such as this. In the past the keynote of pioneer geographical work has been discovery—the search after new facts; in the future it must inevitably become to a greater and greater extent exploration, with its concomitant research into the detail of geographical factors already known in outline and into their bearing upon human polity.

We may now refresh our memories as to the gaps in the charts of the polar regions that yet remain to be filled; blank spaces that stand in our atlases as a reproach and an incentive to every geographer that opens them. In the north polar regions the unknown has been reduced to a single area, although a large one. To the north of Behring Strait lies a space larger than the whole of Greenland which is entirely unexplored. Our ignorance about this tract may be indicated by the fact that experts hold diametrically opposed views, based on the strength of tidal and drift phenomena, as to whether it holds a polar land or is merely an addition to an unbroken polar ocean. The consensus of opinion, however, favours the view of Dr. Nansen, who believes it to be sea.

The solitary track of the *Fram* on her famous drift flanks this supposed sea in the direction of Asia, and we hope that this track may soon be paralleled by that of the *Maud* under Captain Amundsen. There are other, though much smaller, gaps in our knowledge of the Arctic. As late as 1913 one such hiatus was filled in by the discovery of two large islands to the north of Cape Chelyuskin by two Russian ships. Doubtless as exploration continues many more individual tracts of land will be added to the maze of islands which fringe a great part of the Arctic Ocean.

Against these gaps in the north may be set off many achievements in recent years. Amongst these we may mention the remarkable work of the Danish expeditions in completing the map of North-East Greenland, with which are connected more particularly the names of Erichsen, Rasmussen, Mikkelsen, and Koch. The Canadian Arctic Expedition under Mr. Stefansson has carried out similar detailed work in mapping the archipelagoes to the north of Canada. The leader of this expedition has indeed created a new precedent in methods of exploration, an achievement confined to very few of the polar pioneers, and one which will be referred to in detail later in this paper.

A study of the map of the Antarctic regions reveals a far more backward state of affairs. Here we find a mere fringe of the known surround-

ing a vast unknown interior traversed only along two convergent lines, the routes of Shackleton, Amundsen, and Scott to the pole. The fringe itself is far from being complete, there being at least two yawning gaps in the somewhat ill-defined coast-line of the continent, one facing the South Atlantic and the other facing the South Pacific. We do not even know for certain that the land is in the form of a single continent: indeed, the

North Polar Regions: Tracks of Explorers and Drifts of Ships. The large unexplored area defined by dotted boundary

possibility of its being two, separated by a superficially frozen strait, has proved a fascinating subject for more than one theorist. The amount of work yet remaining to be done can perhaps be emphasized best by calling attention to the fact that only in one sector, that immediately to the south of Australia and New Zealand, have land journeys been made within the Antarctic Circle. Coasts have been seen and seas explored elsewhere by

ships south of that line, but only momentary landings have been made and no journeys.

It has not been for lack of effort that these gaps remain. Apart from the siege of the Pole itself, which was reached twice within less than ten years from the first deliberate attempt, there has been the less prominent but equally useful work of extending the fringe of explored coast carried

South Polar Regions: Tracks of Explorers and Drifts of Ships. South polar land shaded

out by several expeditions. Conspicuous among these in the richness of its geographical results was the Australasian expedition of Sir Douglas Mawson in 1911–14.

Inseparable from the results achieved are the brilliant failures and the tragedies of polar travel. Of those in recent years space permits mention of only a few. The fatal journey of Erichsen, Hagen, and Brönlund in

the north of Greenland provides a story for Danish posterity as moving as that of Scott and his pole party has done for England. For indomitable personal effort one naturally points to the wonderful journey of Mawson after the loss of his two companions, while for the supreme qualities both of leadership and seamanship it is hard to equal the story of the last expedition of Sir Ernest Shackleton.

Our review of the past thus gives spur to the future, both in pointing out the gaps yet to be filled and in citing the achievements by which their extent has been so far delimited. A less idealistic aspect of the subject, but one which has faced all promoters of polar expeditions, is the commercial value of polar exploration. It is to be regretted that the answers to queries on that point have so frequently been misleading. It is as wrong to deny any practical value to such exploration as it is to claim for it absurd commercial prospects, and we must try and get at the truth of the matter.

It must be remembered that nearly all the older expeditions had as one of their objects discoveries of immediate practical value. It is only in recent years that a type of expedition has grown up which claims to give first place to scientific discovery.

It may be said at once that, judged by the past and over a long period, polar exploration in the northern hemisphere has paid. It is characteristic of polar work that the avowed objects of most expeditions have rarely been attained, but that in the course of those attempts discoveries were made which proved of value. The search for the North-East and North-West passages, never really successful, led more or less directly to such industries as the whaling in the Greenland seas, the fur industry in high latitudes, the trade with North Russia and Siberia, and the fossil ivory trade of the New Siberian Islands. Almost any one of these commercial outcomes of polar work has produced profits comparable with the expenses of all the north polar expeditions put together. In the same way and perhaps with even more assurance we may state that south polar exploration, viewed broadly, has paid for itself.

The two industries which the Antarctic can claim are a short-lived fur-seal trade which flourished for only two years (1820–21), and the whaling industry which may be said to have commenced in Antarctic waters about 1904 and is in full swing at the present day. The value of these two industries to the world may be placed with safety at not less than twenty million sterling since their inception. A direct connection can be traced between the reports of expeditions on the seals and whales of the south and the establishment of the sealing and whaling stations. As the total cost of all expeditions since 1840 appears to have been less than two million sterling (including the cost of publishing results), it is evident that the past work has been justified from a commercial standpoint, though the work may not have always had that end in view.

From past experience therefore we may be entitled to expect that the

polar regions will furnish further commercial surprises in the future, though it is impossible to say exactly what they will be. It is, however, possible to forecast the extension of the present commercial activities, and a little attention may be devoted in this connection to the young and flourishing whaling industry based upon the Falkland Islands, but carried out in sub-Antarctic waters. It is the subject of a very illuminating and important report by a departmental committee of the British Government published in April of this year. The report shows, amongst other things, that the industry is extraordinarily lucrative, but that it requires careful control in order to conserve the supply of whales. It has been a result of the lack of such control in the past that the whaling industry is now almost extinct except in polar regions.

The area of the Falkland Island Dependencies is probably the last outside the Antarctic Circle that can be used as a centre for this type of whaling, but there is one beyond the Circle which is untried, and which for the number of whales is probably better suited still for commercial exploitation. The Ross Sea in the Australian sector is remarkable for the number of whales observed there by all expeditions. If the demand for whaling products should increase, there is little doubt but that the exploitation of this sea will be attempted. Being within the fringing ring of more or less permanent pack-ice, whaling could not be carried on in this area by quite the same methods as are used at the Falkland Island fisheries. For instance, wooden ships would be essential, and land factories would probably have to be established instead of the floating factories used in the South Shetlands. Once in the Ross Sea the navigation problems are simple, and the harbours available and already known would probably suffice, though the season would be a very short one. It is to be hoped that when the Government institute the inquiry suggested in the report referred to, they will take steps to control the private exploitation of the Ross Sea area, and so prevent the extermination of the whales in this their last stronghold. From the geographical point of view we should welcome the coming of any industry that is likely to add to our knowledge of the less accessible portions of the globe. The divorce of science from industry is the last thing the geographer should wish for or encourage.

The aspect of modern polar exploration which is most difficult to justify in so many words to the general public is its purely scientific side. The phrase "scientific inquiry" is usually considered by the uninitiated to mean the investigation of problems of pure science having reference to phenomena which are without direct practical application. It must not be forgotten, however, that the pure science of one decade is often the applied science of the next. For that reason, if for no other, the encouragement and prosecution of pure science is amply justified. The pursuit of knowledge for its own sake has its own array of arguments just as valid as those in support of art, travel, or any other of the more

abstract activities of cultured peoples; but for the moment let us endeavour to assess the value which may be expected to result from the solution of those scientific problems which require polar exploration for their complete study.

It is most important that all who are interested in polar work should have a clear idea as to why it should consist so largely of the meticulous collection of data in various branches of science. The only way in which that clear idea may be attained is by visualizing the world as a globe of infinite diversity of form, climate, and process, all parts of which are interrelated in a most complicated way, so that whatever happens in one region exerts an influence on all the others.

When we read of the attempts of Herodotus and other Greek philosophers to explain the annual flooding of the Nile we are apt to smile in the fashion of our enlightened age and suggest that they might have gone to the tropics to find out instead of building hypothesis on rumour. I am afraid that posterity may have similar grounds on which to criticize the present generation when they read of our endeavours to explain, for instance, the circulation of the atmosphere by hypotheses based upon data collected only in temperate and tropical regions. The analogy is indeed apt, for the argument employed in Herodotus' day against going to find out on the spot was exactly that used to-day against polar exploration. Men in a position to encourage and finance geographical discovery preferred to concentrate their efforts upon problems likely to give a more immediate return.

The fact is, the scientist himself is rarely prepared to define exactly his objective, far less to predict the ultimate value of his experiments. If Faraday had been asked why he was experimenting with wires and pith balls, we should not have expected him to answer that within a hundred years the world would be getting most of its energy in a form consequent upon his experiments. It is therefore necessary to be content with somewhat generalized answers as to the direct value of scientific observations in polar regions.

The science of meteorology perhaps affords the best example of the systematic collection of apparently irrelevant data in polar regions. In all recent expeditions a considerable portion of the time, not only of the scientific staff but also of the rank and file, has been employed on the amassing of regular and continuous weather observations. Let us see if it is possible to trace any direct connection between the data thus obtained with infinite trouble and the larger problems of meteorology which affect the habitable portions of the globe.

It is obvious that the final aim of that science as regards utility is to obtain foreknowledge of the weather so as to be able to predict with accuracy. It must be admitted that meteorologists are at present a long way from realizing this ambition, and it is inevitable that this should be so until they have really examined all the factors governing the weather.

They are dealing with an atmosphere obeying physical laws dependent on a variety of circumstances. Amongst the most prominent of these are the distribution of land and water, the movements of ice and water-masses, and last but perhaps most important of all, the temperature gradient from the equator to the poles. In this system the equatorial regions function somewhat as the boiler of a heat engine, the polar regions as a pair of condensers. Naturally it is impossible to understand or control the engine if we study only the boilers and neglect the condensers.

The aim of the meteorologist is therefore to acquire further knowledge of polar weather, not in the terms we are accustomed to, but in the general terms of the transference of energy. For this the systematic collection of data is essential, and these data he must compare with those of temperate regions taken at the same time. Only in that way may he hope to evolve the laws by which our weather is governed, and from them begin to predict weather and seasons with confidence. It is data that he wants, from all parts of the globe and over extended periods of time.

The immediate problem of the future is therefore to enable him to collect his data from as wide an area as possible. The requirements can, in fact, be satisfied only by the establishment of permanent or sub-permanent stations within the polar circles. Such a station is not in itself a big or expensive matter. The essentials are a moderately small number of specially adapted instruments and a few observers who take it in turn to operate and set the instruments. There are sundry subsidiary operations which are very useful, as, for instance, the ascertaining of the upper-air movements by means of pilot balloons. The expense and difficulty does not lie in the constitution of the station itself, but in its establishment on the polar land and the maintenance of connection with it. Wireless telegraphy affords a handy means of dissemination of data, and would reduce the number of relief expeditions.

The establishment of stations in the Arctic is already being undertaken, and the Argentine Republic and Australia have set a good example in the southern hemisphere. But the meteorologist will not feel satisfied until he has observations from higher latitudes than the present stations.

Oceanography is another branch of science which is dependent for a great part of its data on the polar regions. The term is not very definite, but for our purposes we may use it to include, not only the physics and biology of the sea, but also the survey of the polar oceans. It has already been shown that the greater part of the useful products derived from high latitudes comes from the sea, and on that account alone we should be ready to support further investigation in the hope of developing yet more sea industries. The colder seas have a far more direct effect upon our daily life than that, however. It is well established now that there is a continual interchange of water between the tropics and the polar circles, the dominant direction of the movement being polewards in the sub-surface water and equatorwards in the bottom water of the oceans. The

existence of submerged ridges on the sea floor has a profound effect in deflecting or banking up the waters of the drifts or currents by means of which the circulation takes place. The temperature and salinity of the sea in any one place are therefore dependent to a great extent on the nature of the obstructions on the bottom, and these in their turn may be the controlling factors in the distribution of edible fish, the larval forms of which are particularly sensitive to small changes in either of these factors. We may therefore say with considerable truth that the amount of melting ice in the polar regions will have an effect on the furnishing of the breakfast table. Nansen and Helland Hansen have already indicated some of the possible effects on our fisheries of variations in the polar drift, but their results are obviously provisional. It is impossible to go further into the intricacies of the subject, but the argument depends upon the fundamental fact that all animal life in the sea depends ultimately on the distribution of the more minute forms of plants and animals which are not motile, but are carried about by currents and drifts. Whether the study of the herring or the whale is in question, we therefore require to know all we can about the temperature of the oceanic waters, their circulation, and their composition.

Under the other divisions of polar oceanography come other matters of practical importance. The careful charting of the seas of the world must always be of prime importance, and wherever industry encroaches on the polar seas that duty is of particular urgency. The collection and publication of information about the state of the ice on trade routes such as the Kara Sea route to North Siberia is a polar matter which should, when properly organised, make a very great difference in the volume of trade.

A beginning has been made in this type of work, and we may refer to the annual ice-reports published by the Danish Government; to the charting and mapping of Spitsbergen by Bruce and the Norwegians; and to the interest that Canada is taking in her polar seas generally. A certain amount of strictly oceanographical work has also been undertaken by scientific polar expeditions in the past, and the results, for instance, of the cruise of the *Scotia* under Dr. Bruce and of the *Aurora* under Captain Davis show that, while a scientifically trained staff can do good work at short notice, yet the best results can only be attained after long preparation and training, and can only be expected from a series of cruises of considerable duration.

The drifts of various ships beset by pack-ice have been of extraordinary value to the science of oceanography, and so many cases have been recorded that there is quite a drift-literature. In fact, we may say that, from an oceanographical point of view, an enforced drift is often a blessing in disguise, though from all other points of view such a catastrophe is disastrous to the prospects of an expedition.

It is clear then that there is a very large and fruitful field for oceanography in polar regions, and it is complementary to meteorology in that it

demands essentially ship expeditions rather than landing-parties. The geographer will naturally desire to see the coasts of the polar lands charted in as soon as possible, but the polar scientist must recognize that the investigation of the polar seas is perhaps of even prior importance.

The case for polar investigation in the interests of the study of earth-magnetism has already been pleaded before the learned societies of England in connection with the expeditions of the nineteenth century, which had as one of their main objects the location of the Magnetic Poles and the revision of the magnetic variation charts of the Globe. Space will not permit of a recapitulation of the arguments which resulted in the despatch of these great expeditions, but a passing reference to one other science is advisable if only for the sake of placing it in its proper perspective in the scheme of polar science generally. It seems to be the general belief that geology has more practical bearing than any other science in polar lands, and certainly it has directed attention to certain industries already established, such as the cryolite-mines of Greenland, the coal-mines of Spitsbergen, and prospects of oil in northern Canada. However, although a geologist, I am afraid I must correct the widely circulated impression that there are vast stores of mineral wealth awaiting discovery on the Antarctic continent. There is little doubt that mineral wealth is there, but that it will ever be found is extremely unlikely, an opinion with which you will probably agree when the case is fully stated.

In the Australian sector of the Antarctic, the only one that has been even approximately examined, we have an area of something like a million square miles of undoubted land, which is, however, covered by an ice sheet except along the coastal fringe. Piecing together the bare patches on this strip, we arrive at an area of about three or four thousand square miles free from the ice covering, and of this less than sixty per cent. is accessible. This means that in all that vast area the amount of land available for examination for mineral content is not greater than an average English county, while the proportion of bare land to the whole area may be compared to the size of London in relation to that of the rest of England. It must be admitted that if in England our search for minerals were confined to the area of London, and if, in addition, London consisted for the most part of unscaleable cliffs or piles of morainic *débris*, we should not waste much effort on a search for gold. The statement that gold and precious stones have already been discovered within the confines of the Antarctic continent are based upon the hastily formed conclusions of men entirely unacquainted with the science of geology. They have no foundation which will withstand examination by experts.

We may now summarize our review of the scientific aspect of polar work and take leave of the subject. While no one can definitely trace an immediate economic value to much of polar science, there is still an undoubted assurance that every observation made is, by adding to the

sum of human knowledge, helping towards the goal of all science, the amelioration of the lot of humankind. There is an added interest in that the polar regions do in all probability contain the key to world problems in science which may at any time make an enormous difference in practical affairs.

It is now necessary to consider an eminently practical side of polar work, the future methods of travel. It will be recognized that the matter of transport is of supreme importance and deserves almost a paper to itself, but it may be worth while to examine some of the methods of the past and hint at some of the future.

In the past several methods of haulage have been given an extended trial, and the result has been to prove that, up to the present, the dog, a relatively small animal with an almost ideal system for extracting the maximum amount of energy from a minimum amount of food, is paramount as a means of locomotion in polar regions. Man himself, and the larger draught animals—the pony, the mule, and the reindeer—have all proved their worth under certain conditions, but comparison of the results of past journeys must inevitably result in placing the dog in a class by himself as regards animal polar transport.

His nearest rival is perhaps the splay-hoofed reindeer, but this animal possesses a constitution delicately adjusted to an Arctic environment and is likely to be confined to that region as a practical aid to extended travel.

Of all types of polar transport, man-hauling is of the greatest interest from the historical point of view. The great success of this method of travel during the later Franklin Search Expeditions caused it naturally to bulk large in the minds of the British explorers who were its chief exponents. It is a corollary of this—the persistence of a tradition long after its usefulness had been outlived—that perhaps more than any other factor prevented the later British Antarctic Expeditions from making full use of dogs. The experience of Scott and Shackleton in their earlier expeditions was such as to encourage the delusion : the result was that the south polar laurels were snatched by a narrow margin from the grasp of the nation whose pioneer work so nearly won the goal on two occasions.

Mechanical transport has been tried in the form of wheeled motor-cars, an aero-engine fitted to a sledge, and a caterpillar tractor ; but except in the latter case no practical measure of success can be claimed. The Scott motor-sledges themselves did not penetrate further south than 50 miles from the main base of the expedition, but their final failure was due to defects in design rather than to the unfitness of motor transport for work under polar conditions. Stronger tractors can be built, but even then the use of mechanical transport will necessarily be confined to comparatively level areas with suitable surface. For travelling over hummocky sea-ice and over crevasses and serac-ed glaciers it appears impossible to design any

form of tractor which can adjust itself to the infinite irregularities of the surface, while the huge snow-covered crevasses of the great Antarctic glaciers will always be a menace to any heavy machine, however long its wheelbase may be.

There remains the possibility of using our latest form of transport—the air-borne machine. The airship may at once be dismissed from the discussion as being far too expensive and fragile except when working from civilized and inhabited centres. Certainly, no airship has yet been designed which could ride out the Antarctic blizzards with their gusts frequently reaching 100 miles an hour and over, while the building of suitable aerodromes from which airships can operate is beyond the reach of the most grandiose expedition. It would seem likely that for some time to come the employment of lighter-than-air vessels in polar work will be confined to hurried journeys from one northerly aerodrome to another *viâ* the air over the Arctic Sea. Valuable reconnoitring work is possible by this means, and the attainment of the North Pole by air is already a feasible scheme. For detailed work, however, the heavier-than-air machine is much more likely to be of value as an adjunct of the scientific polar expedition of the future.

Now that aeroplanes can be constructed to take the air in all ordinary weather and can cover enormous distances without landing, they would at first sight appear to be the obvious type of polar transport of the future. Unfortunately, however, these qualifications by themselves are not nearly enough to satisfy the polar traveller. The first difficulty is afforded by the absence of suitable landing-grounds. It would generally be possible after some search to find a stretch of level snow-covered ice, the surface of which would be from time to time suitable for the purpose. From such a stretch of ground a machine could rise, and on it the pilot could reckon on finding a comparatively safe landing after the lapse of the time taken up by any ordinary non-stop flight. The return to such a landing-place after a long period of time, or the landing at any place not previously reconnoitred from the ground is, however, an entirely different problem. Speaking of the Antarctic, of which I have personal knowledge, I can state definitely that the surface of snow- and ice-fields can never be relied upon to remain constant for any long period. The ground is normally covered with a patchwork of hard, medium, and soft drifts, comparable—to use a simile familiar to home-dwellers—to a landing-ground consisting of alternate bands of hard rock, soft mud, and shifting sand. It would be impossible to distinguish the components of such a snow surface from above with any certainty, for the appearance presented would depend almost entirely upon the lighting up of the individual snowdrifts, and therefore upon the lie of crest and hollow with reference to the incident rays from the sun.

The chances of a safe landing on such country would be very small, and, though uniformly soft and uniformly hard stretches do occur, it

must be remembered that the patchwork surface just described—possibly with complications in the form of hidden crevasses and spikes of pressure ice—is the normal Antarctic snow surface. Uniform soft snow stretches may be overcome by the use of suitable skids or sleigh runners attached to the undercarriage of the aeroplane; hard stretches present no great difficulty; even hard irregularities such as sastrugi might be comparatively easily overcome. The chequered normal Antarctic snow surface is a far more difficult problem, and seems likely to limit the use of aeroplanes to flights between known occupied landing-grounds where signals indicating the state of the surface can be displayed. Promiscuous landing upon the Antarctic land surfaces can only become safe when some device, such as the helicopter perhaps, enables the speed of landing to be radically decreased.

An aeroplane would of course admirably fulfil the rôle of local reconnaissance work within a radius of 200 or 300 miles of the base, and will no doubt be used for such a purpose. Except under special circumstances, however, such as a coast-line inaccessible by any other method, it is doubtful whether the money spent in aeroplane reconnaissance could not be put to much better use in other ways.

So much for exploration by air from a land base. From a sea base, that is by a seaplane from a ship, the case is very different, and not only might excellent work be done, but the inclusion of the equipment in the outfit of any oceanographical expedition might add considerably, not only to speed of manœuvre in pack-infested waters, but to the chances of survival of a beset ship. One has only to think of the numbers of ships that might have been saved from disaster in pack-ice if the navigator, instead of being in the crow's nest, could have been for a time many hundreds of feet in the air, enabled to see at a glance which way to make for open water or less closely packed ice. The seaplane would thus have a very definite value as a pilot alone, even though it could only be employed in comparatively loose pack-ice. As an auxiliary for plotting coast-lines it would be invaluable.

Those who have read the narrative of the cruises of the *Aurora* from 1912 to 1914 will remember how often the ship was prevented by heavy pack-ice from following up and completing her surveys of the coast-line. We must regret that we have not Captain Davis here to-night to tell us whether the conditions of water and weather were not often suitable for the use of a seaplane. From his narrative one would expect his answer to be an emphatic "Yes."

It appears, therefore, that here we have a very proper and legitimate use of the air machine in the service of polar geography, and one which may very possibly lead to discoveries of a kind that could never be attained without such a method of transport. It is certain, for instance, that we shall never know very much about the surface contour of ice-streams such as the Shackleton ice-shelf if we wait for land parties to cross

them, whereas one flight across it of an aircraft armed with a camera would produce sufficient evidence to tell us much of what we desire to know.

The pack conditions around the South Polar continent are such that it is probable that with present methods of exploration another century or more might elapse without adding very much to our knowledge of the undiscovered tracts of country. The employment of seaplanes from circumnavigating ships, themselves keeping well outside the densest portion of the main Antarctic pack, might however, in a single expedition, enable us to complete the broad outline of the continent. For this reason alone, it would seem worth while for the leader of any projected Antarctic expedition to devote a considerable portion of his time to the overcoming of the many technical difficulties which render inadvisable the employment of aircraft for polar exploration without careful previous trial. The enclosing of both engine and crew in a suitably-shaped body would overcome many practical difficulties of temperature and air-blast; the evolution of special alternative landing-gear to adapt the seaplane to emergency landing upon sea ice would be another line of experiment likely to produce fruitful results. These are, however, matters for the air expert rather than for the geographer, and in the past many costly mistakes have been made through the inclination of the leader of an expedition to overrule his technical advisers.

There is yet another aspect of polar travel that requires notice in such a review as this, and that is the type of food and mode of habitation. The evolution of the polar expedition from the hurried visit of a ship during the short polar summer to the wintering of ships, at first involuntarily and then voluntarily, and again to the establishment of huts capable of enduring for years, is an interesting and fruitful study, but polar methods have not yet finally crystallized. The most interesting phase of all is perhaps found in the tendency of the modern polar explorer to imitate many other pioneers of the present day and to get back to first principles.

To live in the Eskimo fashion and find subsistence from the natural products of the region has often been forced upon expeditions in the past, notably in the Arctic in the case of the long journey of Nansen and Johansen, and in the Antarctic in the experience of subsidiary parties from the Nordenskjöld and Scott expeditions. The polar equivalent of the "back to the land" policy has, however, only recently found its most enthusiastic and systematic exponent in Vilhjalmur Stefansson, the leader of the late Canadian Arctic Expedition. As practised by him it is an adaptation of native methods to polar research, and provided there is sufficient experience among the party to begin with, there is every reason to hail it as a great step forward in the history of polar travel. The extent of ground covered by that expedition and the extreme simplicity of the equipment speak for themselves, and seem fully to justify the claims of its leader.

It can of course apply only to regions where there is a local food supply, but it has been shown many times over that the difficulty in the Arctic, at all events, is very often one of capturing the food supply rather than of its non-existence. On this point it seems that Antarctic explorers have a good deal to learn from their Arctic brethren, for although most of the journeys so far undertaken in the south have been overland and far from any possible animal life, there are yet a number of coastal journeys over sea ice which will have to be undertaken in which the "Stefansson" principle deserves earnest trial, even though there are no Eskimo there to teach the elements of primitive existence. The essential points of improvement upon earlier methods are the tremendous saving brought about by the reduction of the dead weight carried in the form of provisions; the use of that most efficient and wholesome form of nutrition—the pure meat and fat diet—to which the dog also owes his unique value; and the employment of snow houses made on the spot instead of carrying tents. A hand-to-mouth existence dependent upon local supplies has its disadvantage from the point of view of a journey with definite scientific objects and only limited time in which to carry them out, but, for general exploration of a partially known country, the increased range of action and independence brought about by the full exploitation of the country's resources is likely to outweigh that drawback.

Intending pioneers of Arctic methods in Antarctic regions must bear in mind two facts: (1) The ultimate direction of movement of pack-ice in the Antarctic is centrifugal towards the stormiest seas in the world, and not, as in the Arctic, towards an enclosing ring of habitable land masses; (2) Antarctic climatic conditions are such that snow suitable for building may be entirely absent over stretches many square miles in extent. An auxiliary tent is an advisable, if not an essential, article of equipment in every extended Antarctic journey. If these two facts are recognized and carefully taken into account, perhaps the most fruitful of all reforms in the immediate future of travel in South Polar regions will be the application of the "Stefansson" method to the southern continent.

We have now dealt with the aims and some of the methods of polar exploration, so far as time will permit, and although it is not possible to sketch detailed plans, it may be of interest to outline the types of expeditions that appear to be foreshadowed in the future. It is noteworthy that in the past the interest in the poles has come in a succession of waves during which the onslaught on the unknown has been very intense, and between which lessons have been forgotten and methods lost. It is particularly interesting to note that one of the greatest waves occurred in the years immediately following the Napoleonic wars.

Speaking only of the Antarctic side of the problem, I am not at all sure that the time is ripe for another series of great expeditions to that quarter. The material gathered since the beginning of the century is hardly digested yet, and, though there is always room for explorers in the

south, we cannot really urge the necessity for another combined attack at the present juncture. This generalization should not, however, be taken to refer to certain specific problems capable of solution by small expeditions—problems of discovery rather than of exploration. In fact, one must here record the conviction that the present is the day of the really small expedition. As long as the purpose of the expedition is a single isolated problem, the work will normally be done far more cheaply and just as well by a small party as by a large.

We have seen, however, that both in meteorology and oceanography, the only two sciences whose claims we have dealt with, the nature of the problems demands sustained effort and rather complex organization, with of course a corresponding increase of expense. There are yet a few long journeys to be made at either end of the Earth, and many purely geographical mysteries still to be solved, and these may perhaps be safely left in the hands of private expeditions of the kind to which geography has owed so much in the past. The instinct for exploration is a ruling passion with a certain very virile type of mind, and there is no reason to suppose but that, whatever may be the difficulties in the way, further expeditions of the same kind will continue to set out from time to time. The larger scientific problems to which we have referred require, however, national rather than private, international rather than national, organization. At the present time, with an overburdened Treasury, with scientific societies hard pressed, and with the general world-situation not altogether reassuring, it is hardly wise to suggest state or scientific bodies as organizers of expeditions. Nevertheless, it is important to realize that it is by the co-operation and on the responsibility of such bodies that these major problems will be best and most cheaply attempted.

Dr. Mill, in his excellent summary of the earlier phases of the siege of the South Pole, has said that the price of a battleship would solve all the main problems of the Antarctic that remain. This generalization is true only if the money were to be spent in the most useful way; if the attack were to be sustained and not spasmodic; and if the plans of the constituent expeditions were to be carefully co-ordinated. The polar regions are international ground, and international co-operation would be the ideal method of attack upon the remaining major polar problems. Tradition and the present world-situation both point, however, to the British as the natural nation to give the signal for the great combined onslaught which shall finally solve the secrets of the Poles. All of us as geographers should be prepared to do our utmost to assist to give the lead as soon as circumstances permit.

One would willingly say more as to possible schemes of co-operation, but they deserve more than the passing notice which is all that we could grant to-night. We turn, therefore, to the last section of the paper in considering what may be done in the meantime to make the best use of what material we have, and to pave the way for the next wave of polar research.

The first thing that a polar explorer has to do when organizing an expedition is to gather information on all manner of subjects relative to his project. Geographical information about the region he is about to visit; details of the equipment found most suitable by former explorers; the best types of provisions and where to obtain them; the selection of the most suitable personnel; the problems he should investigate; and a host of other points vie in engaging his attention during the hectic months of preparation. Much of the information he requires is written down somewhere, but much of it exists only in the minds of men who are scattered over the world; in the forgotten papers of the last expedition that sailed; in the note-books and manuscripts locked away in the desks of private individuals; or published perhaps in books which are out of print and hard to obtain. In a word, the information is in a very inaccessible form.

Again, the first thing a polar explorer should do, after his expedition has returned, is to see that all his results are worked up in the best circumstances, and that his original diaries and notes are deposited where they are available for use. Unless this is done, the results, except the few outstanding discoveries which reach the papers, are of no use to the world, for, like the other information, they remain in private possession and soon become lost to sight of all but the immediate relatives of the man whose possessions they originally were.

The facilities for this working out and filing of results are, however, at present non-existent. If money is available, as is sometimes the case, the facilities for working up results have been improvised, often with much unnecessary expenditure of money and overlapping of work, and by this means, in the case of a few of the larger expeditions, scientific reports of the results have been published. For the most part, however, the observations remain in manuscript and there is no place in which to deposit them where they can be of use.

Here, then, is a chance for the co-operation of polar men themselves. What is required is clearly a centre of polar research: a place where not only can the results be worked up and the manuscripts deposited, but where all information, whether in the form of books, manuscript, or samples of equipment, can be collected ready for examination. The establishment of such a centre has been the subject of discussion by the Trustees of the Captain Scott Memorial Fund for some time. It is probably no secret to many of you that they have now decided to establish a Polar Research Institute with a portion of the funds at their disposal, which were allocated to the furtherance of polar research. Although the scheme is not yet complete in all its detail, the general principles have been decided upon and most of the preliminary negotiations have already taken place.

The first necessity for such an institute is proximity to scientific laboratories and access to prominent scientists. That is to be obtained by

attaching it to a university; and after full discussion of the claims of different educational centres, the University of Cambridge was selected as the most suitable. The authorities of that University have expressed themselves ready to assist, and the institute is to be attached to the Department of Geography there, of which its rooms will form a wing when a building is erected. In the meantime the institute will be accommodated in spacious rooms lent by the Department of Geology.

At present the plans provide for a library and map-room, a museum, and a small set of research rooms. The library will consist of all the ordinary polar literature, narratives, scientific reports, etc., but will also be a repository for all such original records as may be entrusted to it. Besides being a polar reference library of a complete character, it should contain a great deal of original matter which has never been published but should be made available for reference. The museum will aim at being a practical one for reference and information on all the special points of polar material. It should in time contain samples or models or drawings of all types of polar gear from ships to cooking utensils. Its utility will largely depend on the care with which the references and detail of each article are prepared. For instance, a sledge will not merely be exhibited, it will be accompanied by a card recording such things as maker, cost, weight, materials, performance, etc., as well as the proper references to books or manuscript in the library.

The research rooms will provide accommodation for research students and their collections, if any, while at work at the institute. They will not attempt to be laboratories in the ordinary sense. Obviously the nature of the researches will vary within wide limits, and it is impossible to do more than provide working space. For instance, a man who is working at, say, the history of the exploration of Greenland will require nothing more than space in the library, while a botanist recently returned from polar regions with collections would require far more. In the latter case his laboratory work would probably be done in the Botany School, and the institute would be merely a headquarters where he could store specimens, write his thesis, and use the library.

The aims of the institute will include the encouragement and assistance of future polar expeditions and the provision of facilities for the publication of research, whether it be that of expeditions themselves or of independent workers at home. When the institute has become fairly established it should be able to fulfil these aims without difficulty, but its success will depend largely on the support it receives from all those who are interested in polar affairs. The funds allotted by the trustees are sufficient for the foundation of the institute, but they will not extend to the purchase of material and collections, except in special circumstances. It is to be hoped that the library and museum will grow by donations in kind from those interested, each gift increasing the value of the institute as a centre of polar information.

The need for such an institute will be admitted by all who have had anything to do with polar research, whether it be from the point of view of organizing expeditions or of inquiring in a general way on topics of polar bearing. Its utility in the future will also be granted, and it remains for all those who are interested in geography, who are in a position to do so, to support it by donations in kind in order to give it its full value.

The Scott Polar Research Institute will take its name from one of the greatest British explorers, and it will commemorate one of the most striking incidents in the history of polar exploration.

It will be a memorial to a man who above all was characterized by a scientific mind and a determination to advance polar science to the uttermost at any sacrifice of personal comfort, convenience, or safety. The attitude of Scott and Wilson to the more scientific side of their activities was shown once and for all by the way an heroic party, inspired by the great qualities of their leader, struggling along in dire extremity, clung to the last to the precious specimens from the rock cliffs and moraines of the most southerly rock bastions on the path to the pole.

If Scott had survived that fateful journey, his first care would have been the adequate publication of the scientific results for which so many risks had been run. His glorious death, while depriving the expedition of his leadership, yet indirectly removed what would have been his greatest anxiety—the difficulty of raising money sufficient for this purpose.

There can be no doubt whatever in the minds of those who had the very great good fortune to know him personally, that no posthumous honour could have pleased him as much as the establishment of a Polar Research Institute coupled with his name and intended to lighten the burden of his successors and to utilize to the utmost the products of their work.

The PRESIDENT: Before we proceed to the meeting we have a little ceremony to go through. The American Geographical Society of New York have awarded their Livingstone Medal to Dr. Bruce, the great Antarctic explorer. Dr. Bruce unfortunately is not able to be present here this evening on account of ill health, but Dr. Rudmose Brown is here to receive the Medal on his behalf, and His Excellency the American Ambassador has honoured us with his presence this evening; he will, on behalf of the American Geographical Society of New York, present the Medal to Dr. Rudmose Brown. At a meeting when we are going to discuss both the past and future of Polar exploration we thought it a specially favourable opportunity for this ceremony. I will now ask His Excellency to present the Medal.

H.E. the AMERICAN AMBASSADOR: I have in my possession, as the President has told you, the David Livingstone Centenary Medal which was founded by the Hispanic Society of New York on the occasion of the one-hundredth anniversary of the birth of David Livingtone, and is to be awarded by the American Geographical Society, for whom I speak, for scientific achievement in the field of geography in the southern hemisphere. It is my very great pleasure, on behalf of the American Geographical Society of New York, to deliver that Medal to-night to the representative of the distinguished scientist and explorer whom they have chosen as its recipient. To this gathering, of

course, I need say nothing in vindication of their selection, nor can I fail to express my own gratification that no narrow confines have limited their search for a person worthy to receive the Medal, and that they have found such a recipient in the British Isles. To give even a catalogue of all of Dr. Bruce's achievements in the field of geographic exploration would be beyond either my powers or your patience, but since the medal is directed solely to exploration in the southern hemisphere, it is well to recount that in 1892–3 Dr. Bruce was the naturalist of the Scottish Antarctic expedition, in 1896–7 he was the naturalist of the Jackson–Harmsworth Polar expedition, in 1902–04 he was the leader of the Scottish National Antarctic expedition. He was the discoverer of 150 miles of the coast-line of the Antarctic, named by him Coats Land, and has bathymetrically surveyed great areas of the South Atlantic Ocean and the Weddell Sea. He was for many years the Director of the Scottish Oceanographical Laboratory of Edinburgh, is an LL.D. of Aberdeen University, and a Fellow of the Royal Society of Edinburgh, and I feel for myself that it is not only a pleasure but an honour to deliver this tribute to so distinguished a scientist from his brothers in science across the sea.

Dr. Rudmose Brown: Your Excellency, I am asked by Dr. Bruce to thank the American Geographical Society for the high honour that it has conferred upon him, and you personally, Sir, for your kindness in coming here to deliver the Medal. Dr. Bruce wishes me to assure you that he considers it a very high honour indeed that his work should be recognized by the countrymen of such great explorers as Wilkes, De Long, Greely, Peary, and others. I will convey this Medal to Dr. Bruce, and your kind words, Sir, in presenting it.

The President: This Society has always taken a very special interest in Polar exploration and discovery, and will continue to do so. This evening we have to address us Mr. Debenham, who is an Australian by birth, and whose first adventure outside Australia was to the Antarctic Continent under the leadership of Captain Scott. Mr. Debenham is now engaged in work on Polar research at Cambridge, and we are glad to welcome him here this evening. I will ask Mr. Debenham to give us his address.

Mr. Debenham then read the paper printed above, and a discussion followed.

The President: Our scientific men are not always quite so guileless as they appear on the outside. You will observe that all that the lecturer has been saying, first of all in his artless way about the oceanography, geology, and meteorology, and many other sciences, and then about the horses and dogs and motor transport, was leading up to the point that a Polar Research Institute should be established, and then that the one place in the whole world in which one should be founded was at Cambridge University. By an extraordinary coincidence the lecturer is a member of the University of Cambridge, where he holds the Lectureship in Surveying and Cartography which bears the Society's name.

Sir Ernest Shackleton: I have listened to Mr. Debenham's lecture with much interest, having been associated with this sort of work for many years, and I fully uphold the starting of a Polar Institute. Mr. Debenham defined various difficulties which beset Polar expeditions, but he left out the most important one of all, that is finance. If the Polar Institute has any power in the way of finance, I personally would be very grateful to them, for I know of no Antarctic expedition except that of 1901–04 that has gone out fully financed. And while on the subject of expeditions in general, I think it is a false position to put oneself in, to say one goes out absolutely for science. One

goes out mainly for the adventure of it, and to hide oneself behind the cloak of science is not quite honest. I hope when the Institute does start it will persuade those that can, to give. Mr. Debenham remarks that the South Polar explorer has much to learn from his northern brother, as regards equipment and transport. I hold that the two are diametrically opposed. You cannot go 5 miles into the Antarctic without carrying the full supply of food. In the Arctic you can do it, but any one who proposes a journey on the sea ice in the Antarctic is courting disaster. Anything that I can give the Institute in the way of records, equipments, or experiments I shall be very glad to hand over, and I trust the Institute will become an advisor, in a humble way, to the Geographical Society, which is the keeper of the geographical conscience of this world, and which showed its good sense recently in not giving its countenance to a proposed Antarctic expedition which was based upon imagination and without stability.

Dr. G. C. SIMPSON: There is not one of us who has been on a Polar expedition who is not constantly being asked the question, "What is the good of it?" I therefore welcome Mr. Debenham's paper, because this is, so far as I know, the first paper which gives well-thought-out and well-expressed reasons. It behoves every one of us, not only to read it, but to learn it, so that when we are questioned we can bring these arguments out straight away, and for this reason I think Mr. Debenham has given us a very valuable paper to-night. He has mentioned three reasons for Polar exploration, first of all the commercial then the scientific, and finally the spiritual. But there is probably also another and that is the love of adventure for its own sake. Sir Ernest Shackleton has said that what drives men out is the desire for adventure. I quite agree. I do not think any man has joined an expedition who did not want the adventure, but that does not mean that men have not gone out with the real love of science. This was typically shown in Captain Scott. Scott really did love the scientific work, and I know that he was looking forward to a second year in the Antarctic after finishing his journey to the Pole, so that he could devote it to scientific work. Captain Scott was really seriously keen on the scientific work, and I think it is perfectly right for us to say his expedition was a scientific expedition. I would like to limit my remarks as far as possible to meteorology. In meteorology we have the science of the atmosphere, but it is the science of the whole atmosphere, and we cannot have our science complete until we know the conditions over the whole world, and until we know what is happening in the Antarctic we really cannot know completely why things happen here in England. Before Antarctic expeditions were started, it was considered that there was a low-pressure area at the South Pole, with a great whirl of air right round it known as the "roaring forties." With the pressure lowest at the Pole, the air would flow inwards, ascend, and then flow out again in the upper atmosphere. When expeditions went south they found that this was not the case. The Antarctic was found to be an area of high pressure, and the air, instead of flowing from the west right round the world, was flowing from the east, and instead of the air going in, it was coming out. This effected a radical change in our conception of the circulation of the atmosphere. Then again, until Captain Scott's expedition went south, it was generally believed there were great cyclones over the Antarctic Ocean, each one covering a tremendous area—the northern edges were supposed to brush the Australian continent, and the southern edges to reach the Antarctic continent, and it was supposed that these gave rise to the storms of the Southern Ocean and to the blizzards of the Antarctic. It has been shown that there are cyclones over that sea, but they are very much smaller, and the pressure changes down in the Antarctic are

not governed by cyclones as in England, but by great waves of pressure which travel outwards. These are facts which could not be found except by going south, and until one has been there and examined them, we cannot have our science complete. With regard to the future, there is any amount of room for new work, but we cannot do it by sending out expeditions for a year at a time. The thing we need now is to set up a meteorological station and keep it in constant action for many years. We must know the normal conditions and then find out how each year varies from the normal, and thus be able to find how things are correlated between the Antarctic and the rest of the world. It would be quite an easy matter to fix a base station in McMurdo Sound. That is a place where it is possible to take a ship every year, and I would like to see a permanent observatory fixed there. The chief expense connected with it would be the maintenance of a ship to go backwards and forwards to Australia once a year. You would never lack men who would be willing to go and do a year's work in the observatory. We must have that, but, speaking for meteorology only, I think we do not need a new expedition just at present. We have got so many data to digest that we have enough to keep us busy for a certain length of time. We have yet to receive all the meteorological data of Sir Ernest Shackleton's first expedition ; all the data of his last expedition ; all the data of Mawson's expedition, none of which has yet been published. We have therefore got plenty of work to do without another expedition. Now with regard to the Polar Institute. I welcome it, and I think it is a fine and great idea, but I am not quite sure that I want it to be mixed up with finance. What we want is something which will co-ordinate our scientific results and teach us what to look for, and how to look for it, and to place before us the experiences of previous expeditions. There is one thing I want to suggest. I understand it is not proposed to connect with the Polar Institute any personnel. I would like to see connected with this Institute a body of people who have been in either of the Polar regions—a people who have made a name for themselves in Polar research—so that when the Government wish to know whether a certain expedition should be supported they may be consulted. In the same way they may even be able to advise such a Society as this. In conclusion, I should again like to thank Mr. Debenham for giving us such a well-reasoned statement of the needs of Polar exploration.

Dr. E. L. ATKINSON : Captain Scott found pleasure in meditation, and some of his thoughts are recorded in his diary, and those who have read it find it exceedingly interesting and fine. One of his thoughts noted there was " Science is the foundation of all effort." That to my mind was the guiding principle of Captain Scott. Every scientist of the expedition came in close contact with the leader, and will vouch for the fact that if he took an interest in a science he rapidly acquired efficiency in it and became a respected protagonist in subsequent discussions on the subject. Fortunately in this expedition one journey was made from a purely scientific point of view. I refer to the winter journey made to Cape Crozier by Wilson, Bowers, and Cherry Garrard to study the habits of the Emperor penguin, and I think there will be general agreement that this was one of the finest ever made in the history of Polar exploration. The conditions under which this was carried out will be more fully brought to your notice in two histories of the expedition which are now being compiled. The whole future and interest in Antarctic and Arctic exploration are involved in the question whether it is more important to do exploration which is geographical only or for the general advancement of science, with recognition that some of the findings obtained may be of no immediate apparent use but may ultimately be of benefit to mankind.

With regard to Mr. Debenham's lecture, I am sure we have all enjoyed it very much. I have been greatly interested in the question of the utilization of flying machines, and think that if they are to be of use it is essential to carry out all flying operations from a land station, where efficient examination of the planes and satisfactory repairs are possible. I do not think much can be done by seaplanes from a ship.

The PRESIDENT: I entirely agree with what Sir Ernest Shackleton said about the necessity of a spirit of adventure being behind these expeditions. But I think that the two—the spirit of adventure and the pursuit of science—go admirably together, because when men of adventure go into these terrible places—I have never been in the Polar Regions myself, but in other disagreeable places—they like to feel that all their efforts and all the hardships they undergo may result in the attainment of some knowledge which will be of real use to the human race. The lecturer admirably put the aim of science before us—I think he said, "the amelioration of the lot of mankind." I suppose that it is the adventurous spirit which all scientific men need in their pursuits. Unless they had it behind them in their work they would not get very far even in laboratories. After all, it is only a matter of time before all the items of knowledge do come in useful for that end which Mr. Debenham has described. It may be sooner or it may be later, but in the long result the utility of each will be found. The human race will never be satisfied until it has completed its knowledge of its surroundings. We want to know everything about this planet, even its furthest confines, because we not only have to adapt ourselves to our surroundings, but in the true spirit of man we have to master them. And we cannot master them until we have full knowledge of them. We therefore welcome such papers as this, which has put in a clear and concise way what are the objects of Polar research and exploration, and which will be of value to us in forming our opinion of the work to be done in the future. The question of finance has cropped up, and I do not agree with the speaker before last that we can entirely afford to neglect finance, but speaking as one of the Scott Trustees I can say that we—that is, the Lord Mayor, the President of the Royal Society, and the President of this Society—will do our best to devote the Scott Memorial funds to the endowment of this Research Institute at Cambridge. I may say that it is largely due to the eloquence and the energy with which the scheme was put before us by Mr. Debenham that Cambridge was selected. I did put in a humble plea for the Royal Geographical Society, but I could not prevail against the eloquence of Mr. Debenham on behalf of Cambridge. It has been a very instructive paper that we have heard this evening, and we would in a special degree like to thank Mr. Debenham for having given it to us, and for having so well described the spirit in which Polar exploration is to be conducted.

THE MOUNTAIN-GROUP OF OLYMPUS: AN ESSAY IN NOMENCLATURE

D. Baud-Bovy

[We are happy to publish this account of the ascent of Mount Olympus, and the valuable examination of the nomenclature of the mountain. But it would be contrary to the long-established practice of this Society to accept the suggested attribution of personal names, however distinguished, to mountain

peaks which, if they have no recognized native name, are best distinguished by descriptive names. The descriptive names, as La Roche Tarpéienne, given by the author are left in French on the map and translated in the text; but the names to be finally accepted must be Greek. There is however at present some doubt of the right form of the names which appear to be Greek. On the Greek edition of the Austrian 1/200,000 map the village called Kokkinopoulo by the author is given as Kokkinoplos; the author's Bichtes is Bektas on the Austrian 1/200,000. In such cases we have left the author's spelling in the text, and given the alternative on the map. Where the difference is due to varying practice in transliterating from the Greek, we have printed the English form, Kalogeros, not Kalogheros.—ED. *G.J.*]

A COMPLETE description of the massif of the High Olympus is impossible at the present moment: our maps are both inexact in the general view they present, and they lack the necessary detail. Of the names, all but five or six are uncertain, since they vary with the period, the traveller, and, above all, with the guides employed by him. According as these last hail from Litokhoron, from Katerina, or from Kokkinopoulo, they speak of the same summits under different appellations. Thus it was that the monks of the convent of Saint Denys, or their servants, informed Heuzey that the central rock-pinnacles—the high peaks of shell-like form—bore the name Kalogeros—the Monk—and were accounted to be the tomb of Saint Denys; that our guide of 1913, the hunter Christos Kakkalos of Litokhoron, assured us that these same summits had no name and assigned that of Kalogeros to the complex of summits further south; and that a muleteer of Kokkinopoulo christened them the "Three Stones." This same man, who had accompanied M. Boissonnas and myself in 1919 on the heights of Sala-tula (the mass which, west of Olympus, commands the deep and rocky trench of Xero-lakki), declared to us that the northern Saint Elias was the Saint Naum, while he gave the name Saint Elias to the summit which the geologist Cvijić knew as Isto-Cristaci. So, too, the name of Ichuma-Trugut, given by Heuzey to one of the peaks which border the valley of Karya—the one which the Abbot of Agia-Trias and the shepherds told us was the Sarai (Seraglio or palace)—is unknown at the present day, alike to the inhabitants of Kokkino-poulo and to those of Skamnia. And one might multiply such instances. In the midst of all this it is more useful, however, to determine the landmarks which can be fixed at the present moment.

In his account of the ascent of the Skolion, accomplished in 1914 by Messrs. Farquhar and Phoutrides, Mr. Douglas Freshfield gave an illuminating *résume* of the information so far collected (Douglas W. Freshfield, 'The Summits of Olympus,' *Geographical Journal*, April 1916). The general conclusions which he drew from this first group of data have supplied the outline of the picture, or I should rather say the sketch, which I am about to attempt here.

As is easily seen by a glance at the map, the mountain group of Olympus, which rises as an edging to the Thermaic Gulf between Thessaly and Macedonia, and which is bounded on the south by the Peneus, on the north by the Bistritsa (the ancient Haliacmon), is subdivided by the defiles of Petra and the valley of Karya into three distinct parts: the Pierian Mountains, which border Macedonia, the Higher Olympus in the centre, and the Lower Olympus, whose last spurs fall into the Vale of Tempe. It is with the Higher Olympus only that these notes are concerned. As Mr. Freshfield says, we may adopt the summary description given by Tozer: two ranges that run from east to west and are connected at their western end by a high rocky crossbar which contains the highest summits.

In the north, the St. Elias, and the less important peak which we have named the Jacques-Philippe after our faithful courier, are the points where this central crossbar is jointed into the northern ridge. In the south the articulation is much more complicated: the Skolion and the Isto-Cristaci which, at the other extremity of the central peaks, form the counterpart of the St. Elias and the Jacques-Philippe, are as it were duplicated by a series of conical summits, of which the St. Anthony is the most important; and the central ridge is itself reinforced near the point of junction by the neighbouring bosses which separate the valley of Karya from that of St. Denys. It is by hazardous tracks across this knot of peaks, all of very similar aspect, that communication is maintained between St. Denys and Kokkinopoulo on the one side and Agia-Trias, Skamnia, and Sparmos on the other.

The accompanying sketch makes no claim to topographic accuracy. It corrects that published with the narrative of our ascent of the highest peak in 1913,* and must be taken as nothing more than a diagram, wanting proportional accuracy and extremely incomplete, but still permitting those interested in the subject to follow more easily the descriptions of those who have visited the mountain. Such travellers have been, so far, few in number.

In the last days of July 1830 an English diplomatist, D. Urquhart ('The Spirit of the East,' 2 vols., London, 1838), set out before daybreak from the convent of Agia Trios, above Sparmos. In company with a guide he reached a col whence he had a view of the mountains of Athos across the Thermaic Gulf. Next he climbed a first summit which he calls Sto-Stephano, and then made his way to one of the north-western summits (perhaps the St. Anthony) which seemed to him higher, and whence he could see Thessaly under a haze gilded by the setting sun. After an icy-cold night before a shepherd's fire he descended again to the monastery.

* 'La Grèce Immortelle: Conférences par MM. Th. Homolle, G. Deschamps, Ch. Diehl, Alf. Croiset, L. Bertrand, A. Andreades, D. Baud-Bovy'; illustré. Editions d'Art Boissonnas, Genève, 1919.

The French archæologist Heuzey,* in 1856, climbed one of the summits of the southern ridge which he names Ichuma. Afterwards, from the convent of St. Denys, he made an unsuccessful attempt to ascend the St. Elias peak by way of the Mavro-longo.

The German geographer Henri Barth ('Reise durch das Innere der Europäischen Turkei,' by H. Barth, Berlin, 1864) started from Kokkinopoulo about the middle of October 1862, and slept in a shepherd's hut at the foot of the Skolion which he climbed the next day; his mules and their drivers having meanwhile camped on the Bara plateau near the col of Agia-Trias. From the Skolion, after reconnoitring the two vast abysses of Trani- and Mikro-Gurna, into which the north-west face of Olympus plunges, he gained the eastern base of the central peaks. Following one of the narrow terraces which dominate the rocky cirque of Phtina—the termination of the St. Denys Valley—he reached St. Elias and discovered that the highest point of Olympus is not on this summit but on one of those whose escarpments he had followed. Two years later the English traveller Tozer ('Researches in the Highlands of Turkey,' 2 vols., London, 1869) climbed the St. Elias peak from St. Denys and obtained evidence confirming this view.

In 1869 Gorceix, member of the French School of Science at Athens, gained the southern summit which the Austrian and Greek maps name St. Anthony, or Kalogeros (the Monk).

From this time on, however, the original *Klephtes* or Greek partisans, who during the War of Independence made the impregnable Olympus their rendezvous, had little by little transformed themselves into mere ordinary brigands. Still very numerous, they made any excursion into the mountains extremely hazardous, and it is for this reason that, although close to the maritime highway from Athens to Constantinople, and in spite of its four millennia of fame, Olympus was at the opening of the twentieth century as unknown as the greater part of Central Africa.

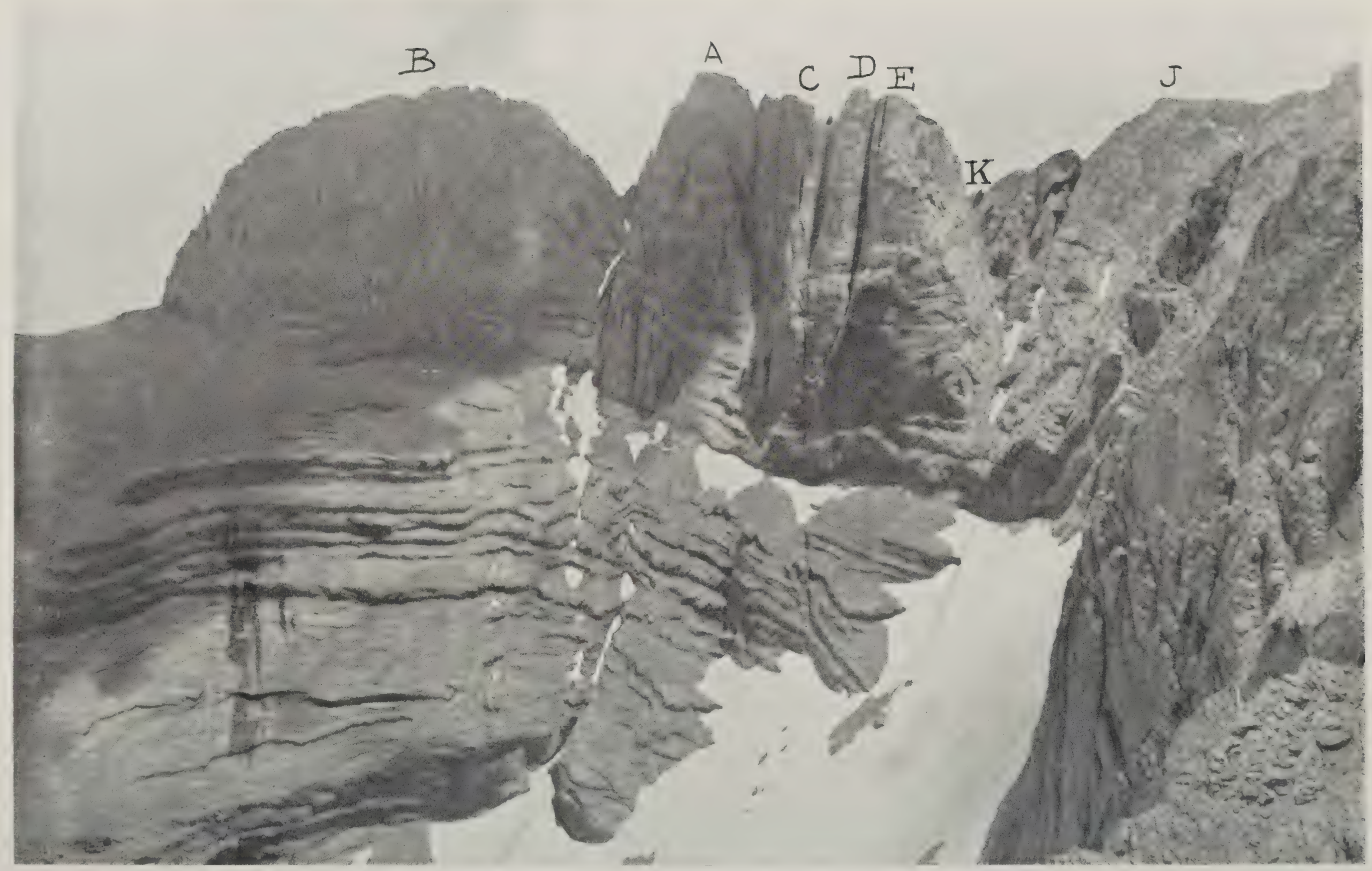
Such is the comment of the Engineer Richter, of Jena, who in 1909 made his way alone and without hindrance from Litokhoron into the Valley of Sparmos ('Meine Erlebnisse in der Gefangenschaft am Olymp,' Ed. Richter, Leipzig, 1911). Having ascertained that the central peaks were untrodden, he undertook a new expedition in the spring of the following year, but a snowstorm frustrated his purpose. In 1911 he renewed his attempt a third time, but could effect little. Whilst engaged in a reconnaissance in the neighbourhood of Kokkinopoulo he was captured by brigands, who murdered the two Turkish gendarmes given him as escort, and he only recovered his freedom after four months of durance vile. To secure it the Porte had been forced to pay a ransom of 500,000 francs.

* 'Le Mont Olympe et l'Acarnanie,' par Léon Heuzey, Paris, 1860. See also 'Itinéraire de l'Orient,' Dr. E. Isambert. Collection des Guides Joanne, Paris, Hachette, 1873; and 'La Grèce,' B. Haussoulier. Same Collection, Hachette, 1891.

In 1913 circumstances had changed. Throughout the whole range of Olympus, now entirely Greek, the *Klephtes* had lost the advantage of being always able to put a frontier between them and their pursuers. Whilst on the way to present ourselves at the Greek General Headquarters at Demir Hissar, my friend M. Boissonnas and I were induced by an unexpected turn of events to attempt the ascent of St. Elias. A *caique*, chartered at Salonika, took us in one night, thanks to a favourable wind, to St. Theodore, whence we proceeded inland to quarters for the night at Litokhoron. Next day, having made up a party, we paid a visit to the Convent of St. Denys, and then, by a track which joins the old road followed by the priests of Dionysus, we came, at the edge of the woods, to the site of Petrastrunga (Rock Inn), where we camped. On July 30 we started at dawn and reached the *Porta* by the ridge of Kokkino-Vrako (the Red Rock), which forms the northern range, gaining the small chapel which adds a few feet to the summit at 10 a.m. From a neighbouring cone, to which we gave the name Jacques-Philippe, we got sight of the vast chasms of Mikro- and Trani-Gurna, and the precipitous walls of the huge rock-masses which shut out our southward view from the St. Elias peak. We christened it the "Throne of Zeus." Skirting the northern base of this rock we reached the *vurla* (col) of St. Elias, a counterpart of the Porta, whence it is easy to gain the crest of the narrow chine of the Mavro-longo. From this point it was that our guide, the hunter Christos Kakkalos, showed us the solitary pinnacle, south of the Throne of Zeus, which he took, not without reason, for the highest summit.

The Mavro-longo (black forest), which separates the deep ravines of the Kokkino-Vrako from those of the Phtina, leads direct to the bottom of the St. Denys valley, near the sawmill of Prionia, or Christomilo. Here it was that, surprised by a storm, we had to bivouac two days later; and hence on August 1 we started for night quarters in a *khalivia* (woodman's hut) near the Mavro-longo. On August 2, despite the fog, the wind, and the scantiness of our equipment; abandoned by the carriers entrusted with our photographic apparatus, who at the first difficulties refused to budge a step further; but guided by the brave Kakkalos, we gained a jagged summit which we took for a moment to be the most elevated in the whole chain. A gust of wind undeceived us by uncovering the neighbouring peaks: we were on one of the teeth of the cockscomb-like summit which rose to the south of the central peak, separated from it by an impassable cleft. Notwithstanding his bleeding feet—for he had taken off his shoes for this climb—Kakkalos did not lose heart. After a perilous traverse of the eastern face of this ridge, he led us beyond the cleft to the base of a chimney which descends directly from the central peak. One spurt, and in half an hour we had achieved its conquest. The fog had cleared, and our gaze wandered over Thessaly away to Parnassus, over Macedonia away to Pindus; on the Thermaic gulf from Mount Athos to Scyros we looked on all the splendour of Pelasgic Greece. To this

1. SKETCH-MAP OF THE MASSIF OF OLYMPUS, lettered to correspond with the letters on the photographs of M. Boissonnas, of which four are reproduced, and others have been presented by him to the Society's collection



2. THE HIGHEST SUMMITS OF OLYMPUS

B : the Throne of Zeus ; A : Peak Venizelos ; C : the Cock's Comb ; D : the Virgin ; E : the Tarpeian Rock

summit we gave the name Venizelos peak, in honour of the great citizen who has since saved his country, whilst the part of the crest which we had come to first was christened by us the "Tarpeian Rock."

Owing to the fog and the lack of his principal camera, my companion reaped but an incomplete photographic harvest from this expedition, and we planned to repeat it the following summer. When this came, it was the first year of the war. Before it broke out, however, two professors and alpinists, Messrs. Farquhar and Phoutrides, the one an American, the other a Greek domiciled in America, made the ascent of the Skolion during the last days of April, and published in *Scribner's Magazine* (November 1915) a series of admirable photographs of the 'The Snowy Olympus.' Strangely enough, without knowing anything of our climb, they gave the name "Throne of Zeus and Hera" to the complex of central peaks.

Later on, from Salonika, the English Major-General Rycroft accomplished the ascent of St. Elias, by way of Litokhoron, in June 1918 (*Alpine Journal*, June 1919, "Mount Olympus," by C. F. Meade).

To return to ourselves. It was only last summer that, peace having returned, we could at last carry our project into execution. On July 17, having formed our caravan at Katerina with the aid of H.E. M. Adossides, Governor of Macedonia, we reached Kokkinopoulo. Following the route taken by Barth, and correctly described by him, we gained the upper part of the deep valley of Stalamata, and then crossing the alpine pastures of the Odas and the ridges which connect the Isto-Cristaci and the Skolion with the St. Anthony, we descended into a valley situated south-east of this last summit. There we pitched our tent not far from an encampment of nomad shepherds. For a whole week each dawn saw us set out on a new expedition. One day we pushed as far as the edge of the Stavoïdia plateau, whence one has a view of the sea. On another we climbed one of the summits of the southern range, and thence surveyed the whole complex of great peaks. Another time we went down below the Skolion, along the ridges which plunge into the Xero-lakki between the Trani- and Mikro-Gurna, and saw the whole mass of the Throne of Zeus picked out by the light and shade, with the great peak towering above. At last, on July 21, we—that is to say, Boissonnas, one of his sons, and myself—after losing our way once more among the serrations of the Cock's Comb, set foot upon its highest escarpment, much to the terror of our porters, who, as before, stayed behind and left us the whole burden and charge of our apparatus. But we were well repaid for our trouble by the truly divine beauty of the view which met our eyes—by the harmony of the vast array of co-ordinated forms which seemed to mount up from the horizon to the very point of space that we occupied ourselves. Once more we admired the force and truth of expression of the ancient poets when they spoke of "the long Olympus," "the many-headed Olympus," "the snowy Olympus," "Olympus of the numberless folds." We could also, this time at our

leisure, gain a more correct idea of the architecture of the group. Unfortunately the box containing our instruments had gone astray—barometer, thermometer, compass, all were wanting. It seemed to us, however, that if Peak Venizelos exceeds St. Elias in height by some 100 metres, it can only surpass the Throne of Zeus and the Skolion by a score of metres. In 1913 the fog which filled the atmosphere had led us to suppose the difference much greater.*

With the aid of the observations and photographs collected by us during these excursions, and of the diagrammatic sketch that they have permitted us to construct, it remains for us to approach the essential object of this study, that is, to establish a certain number of fixed points in the extremely confused and often contradictory nomenclature of the group. And first it is desirable to explain that many of the names are generic. *Bara* (mpara) signifies a plateau, a grassy combe where as a rule there is water. There is a *Bara* on the road from Petra to Kokkinopoulo; another at the foot of the Sarai, near the pass of Agia-Trias. The country people use indifferently the words *Gurna* (which means bath) or Cazana (Cvijić's *Kazanja*, meaning cauldron) to describe a chasm. *Stalamata* means "drop by drop," and well expresses the aridity of the canyon that one enters on leaving Kokkinopoulo in order to reach the *Odas*. No one has been able to tell me the meaning of this last word, any more than of *Phtina* and *Stavoïdia*.

As I have remarked before, the same names are attributed to different summits, whence many mistakes have arisen. Arrived at the summit of the Mavro-longo Heuzey found himself "à l'entrée d'un vaste amphithéâtre de grands rochers coupés à pic, qui s'ouvre en cet endroit de la montagne, et qui est formé par les escarpements de ses plus hautes cimes. . . . Au fond de ce cercle immense se dresse une roche d'un aspect remarquable, large, déchirée par le haut, taillée en forme de coquille. C'est le second des sommets de l'Olympe,† le plus élevé parmi ceux *qui se groupent au midi*. On l'appelle Kaloghéros, le Moine, et la légende rapporte qu'il sert de tombeau à Saint Dhionysos." Whether he means to give this name to the Throne of Zeus only; to this and to the central peak, separated by a cleft; or to the whole group of peaks, is the more difficult to decide in that the Joanne guides of 1873 and 1891, compiled so far as concerns Olympus under Heuzey's inspiration, contain

* In March 1919 Lieut.-Colonel Wood and Lieut.-Colonel Todd, coming from Salonika, made the circuit of Olympus by aeroplane. The photographs taken during the flight by Colonel Wood, and reproduced in the June number of the *Alpine Journal*, afford supplementary data of great interest on this point. Mr. Meade, author of the article which accompanies the illustrations, supposes the Throne of Zeus to be the highest summit. But Colonel Wood considers that the Skolion, the Venizelos peak, and the Throne are approximately of the same height, though he is inclined to think that the Venizelos peak overtops the two others.

† The first being for him St. Elias.

the note: "Au fond du cercle se dresse, *du côte du Nord*, le Kaloghéros. . . . ;" and on the other hand Heuzey, desirous no doubt of maintaining the supremacy of St. Elias, adds in a note copied into the guide of 1891: "Mais M. Gorceix . . . m'a confirmé que le nom d'Hos Hilias, n'en est pas moins bien appliqué à tout le groupe septentrional des *Sommets*." Without dwelling longer on this point, we may be content to point out that Heuzey, as he shows too on his map, places the Kalogeros among the central peaks. This explains his mistake in charging Dr. Barth with confusing it (as does the Austrian map) with the St. Anthony; it shows, too, that there must evidently have been a misunderstanding between him and Gorceix, when the latter spoke to him of the ascent of the Kalogeros (that is to say, of the St Anthony) which he had accomplished in 1869.

Heuzey, then, names the whole or a part of the central peaks the Kalogheros. Cvijić designates the whole massif under the name "Tres Pipes"; Tozer under that of "Three Brothers"; the people of Kokkinopoulo call it simply the "Three Stones"; Messrs. Farquhar and Phoutrides regard it as the "Throne of Zeus and Hera." We have given the following names to the different summits which compose it, starting from the north: The Throne of Zeus, Venizelos peak, the Cock's Comb, and the Tarpeian Rock; the most elevated point of the last—The Virgin—being still unclimbed, as also the Throne of Zeus. The western precipices of these peaks plunge into the Trani-Gurna or Trani-Cazana.

The name Kokkino-Vrako, "The Red Rock," might be extended to the whole northern range, the spur of which is so designated abreast of the saw-mill of Prionia. It leads up, by the Porta or Zygos, to a small grassy plateau, ablaze with gentians when we crossed it in 1913, which we named the "Meadow of the Gods." It is formed by the meeting of the slopes of the St. Elias, the Jacques-Philippe and the Throne of Zeus. Two cloister-like passages open on its eastern edge—the Porta and the Vurla of St. Elias which is connected with the Mavro-longo. It is continued as a narrow terrace to the east of the great peaks, above the ravines which constitute the Phtina.

The general direction of the line of central peaks is from north to south, but bending to the west at the two ends. This curve is accentuated from the point where a cleft separates the Tarpeian Rock from the arête of the Scholion. This arête is connected, through the Cristaci, with two secondary summits—the Karzaras (Churn) and the Kytros,* as they were named by our guide, Nicholas Vilin of Kokkinopoulo—which overlook the upper part of the defile of Stalamata on the north. These peaks are themselves connected with the Sala-Tula, which forms the left flank of the Xero-lakki, the deep rocky trench which protects Olympus on the west. In its upper part it is divided in two by a secondary ridge which runs down from the Skolion and separates the Trani- from the Mikro-Gurna. In

* Possibly the spot-height 1573 of the Austrian map.

1913 we gave the name Tête Noire to the Skolion. The name might perhaps be bestowed on the rocky spur where the eastern arête of the Skolion terminates above the cleft of the Tarpeian Rock. West of the Skolion it connects with the Isto-Cristaci, which is said to take its name from a famous *Klephte*, but which is not, as supposed by Cvijić, the highest summit of Olympus. The Cristaci and the Skolion, which tower above the chasms of Xero-lakki, are joined on the south, as we have said, to a complex system of conical peaks—the Cristaci by a secondary summit, the Kafigno, to the St. Anthony (or Kalogeros), and further west to the Griva; the Skolion to the bosses whose south-eastern slopes run out into the Stavoïdia, the Bara, and the neck which connects this whole group of domes with those that belong definitely to the southern range.

Besides the names Kytros and Karzaras, those of Kafigno and Griva were given to us by Nicholas Vilin and his companions. They all spoke of the St. Anthony under the name Kalogeros, and of the pastures which lead up thither from the Stalamata valley under that of Odas. But Barth appears to use the same designation for the southern slopes of the ridge which runs from the Cristaci to the Skolion. His baggage animals would seem to have passed north of the Cafigno in order to reach Bara, while he pushed on to the Skolion. On the latter he found the remains of a small ancient building, of square outline, of which traces are still to be seen; we found some enormous bricks on the same spot. It is from this building that, by a tradition difficult to explain, the summit has gained its name. There can be no question of a school, but rather of a watch-tower. Now on the other side of the col which has to be crossed on the way from St. Denys to Agia-Trias the southern peak which Heuzey names Ichuma bore a similar building. The country folk assured him that they had seen there an inscription on a marble slab, but he collected nothing but big bricks. But twenty-five years earlier Urquhart, who calls this summit St. Stephano, saw there marble ruins and *débris* of pottery. There is no doubt that it is this same cone which Tozer calls the "Southern St. Elias," and it is perhaps the one which, among the heights which bound the plain of Bara to the south, is distinguished by Barth as Pnakia.

This peak was spoken of to us by the head of the Monastery of Agia-Trias, and by his chief steward, as the Sarai—"the palace." Like the "School," the "Palace" is an allusion to a building put up by the hand of man. Here, too, we collected some enormous bricks, some bearing Greek characters, and on this account, amid so many names, we incline to that of Sarai. Those of Kalogeros (which ought not to be retained for the St. Anthony), St. Stephano, Ichuma, can quite well be assigned—some to the peaks south of the Skolion, others to those which are linked to the Sarai on the west, north, and east by curved ridges. The shepherds of Bara gave the name Skamnia to the part of the southern chain of which the Sarai is the centre, and Bichtes to that which drops down to Litokhoron. It is by this name Bichtes that the people of Kaiya

3. THE SUMMITS OF OLYMPUS AND THE TRANI GURNA FROM SALA TULA

G : Pic Jacques Philippe ; H : Skolion ; J : Tête noire. Other points as in Plate 2

4. SKOLION FROM THE BREACH AT K, PLATE 2

5. SAINT ELIAS, THE PRAIRIE DES DIEUX, AND THE PORTA (X) FROM POINT G

denominate the summits of Olympus which protect them from the north wind.

Thus, to sum up, the High Olympus is constituted by two ranges, which, though not parallel, run generally east and west. The northern range is that of Kokkino-Vrako, the southern, that of Bichtes. A high rocky barrier running north and south contains three "stones," three "pipes," or three "brothers," quite separated from each other, the Tarpeian Rock in the south, the Throne of Zeus in the north, and in the centre the Venizelos peak, the highest of the three. The point of junction between this barrier and the northern range is the St. Elias. The joint which unites the central peaks with the southern range is more complicated. It includes the Skolion, which forms the counterpart to the St. Elias on the opposite side of the Megali-Gurna, and the Isto-Cristaci more to the west. The St. Anthony and the domes of Stavoïdia link these two summits to those at the western end of the southern range, of which the Sarai is the most important.

I may conclude with the hope that the geographers of the future may not have to correct at too many points the imperfect sketch here traced of the high abode of the gods.

REPORT ON THE EXPEDITION TO KAMET, 1920

Major H. T. Morshead, D.S.O., R.E., Offg. Deputy Superintendent, Survey of India

The following extracts from Major Morshead's report to the Surveyor-General of India are published by permission of the Surveyor-General to supplement the brief narrative given by Dr. Kellas in his report to the Oxygen Research Committee, of which a summary was published in the February Journal.

THE mountain known in India as Kamet and to the Tibetans as Kangmed * or Abi Gamin—the 30th in order of magnitude of the known high peaks of Asia and of the world—is in lat. 30° 55′ and long. 79° 36′, in the Garhwal district of the United Provinces, just south of the Tibetan border. Rising to a height of 25,445 feet, it forms the culminating point of the Zaskar range—a northern bifurcation of the Great Himalaya—and, though forming a conspicuous landmark from the Tibetan province of Ngari Khorsum on the north, yet from the south, owing to its position behind the Great Himalayan Range, its appearance is so modest that till 1849 it remained unnoticed and unmeasured, though but 250 feet lower than the king of the Kumaon Himalaya, Nanda Devi.†

* Kangmed = "the lower snows," as distinguished from the higher snows of the Kailas Range, culminating in Mount Gurla Mandhata 100 miles to the E.S.E. The name has, I think erroneously, been spelled Kangmen in N. Frontier ¼-inch Sheet No. 9 N.E., and on the R.G.S. map of Tibet.

† Burrard and Hayden, 'A Sketch of the Geography, etc., of the Himalaya Mountains.' Kamet now shares the 30th place on the world's list of high peaks with Namcha Barwa, the mountain of identical height overlooking the big bend of the Tsangpo river in the Assam Himalaya, which was discovered in 1912.

The earliest attempted ascent of Kamet was made in Jnne 1855 by the brothers A. and R. Schlagintweit, who reached a height of 22,240 feet on a mountain which they called Ibi Gamin, and believed to be identical with Kamet. Subsequent investigation has, however, tended to the belief that the mountain on which they actually climbed must have been the satellite known as E. Abi Gamin, or Strachey's peak (24,180 feet).

During the succeeding half-century the only recorded adventurers on the mountain are the members of the Great Trigonometrical Survey who triangulated and mapped the area in the years 1872-75. It was near here in the latter year that the late Mr. I. S. Pocock made what remains to this day one of the world's highest plane-table fixings—setting up his board at 22,040 feet.*

In recent times numerous attempts have been made on the mountain. The approaches both from the east and the west were reconnoitred in July and August 1907 by Messrs. Bruce, Longstaff, and Mumm ; but serious climbing was prevented by the onset of an unusually violent monsoon. Mr. C. F. Meade, accompanied by Alpine guides, made three strenuous efforts to conquer the mountain in 1910, 1912, and 1913. On the latter occasion, approaching *viâ* the Raikane valley he succeeded in reaching the col ("Meade's saddle," 23,500 feet) between Kamet and E. Abi Gamin, when his party succumbed to mountain sickness just as success seemed within their grasp.

The late Captain A. L. Slingsby twice attacked the mountain unsuccessfully from the western side, while Dr. A. M. Kellas also reconnoitred the western approaches in 1911 and again in 1914—the expedition in the latter year, which had for its special object the scientific investigation of the effects of high altitude on the human body, being summarily cut short by the outbreak of war.

On the conclusion of peace Dr. Kellas resumed the experiments cut short in 1914, and further arranged for the loan of oxygen cylinders and other scientific apparatus from the Oxygen Research Committee in England, for its despatch to Bombay through the agency of the India Office Stores Department, and for the assistance of the Survey of India in taking delivery of the apparatus in Bombay and transporting it by rail and coolie *viâ* Kathgodam to the base of the mountain beyond the extreme Himalayan village of Niti.

I was fortunate enough to be deputed for the latter task, together with Mr. Laltan Khan of the Survey of India Upper Subordinate Service.

It was hoped that the apparatus might have arrived from England by the end of June, so as to enable Niti to be reached by easy stages on about August 7. This would allow of the remainder of the month of August being devoted to laying out advanced depôts of oxygen cylinders, firewood, etc., as far forward as climatic conditions admitted, with a view to utilizing the first fine weather after the monsoon for the final climb, before the arrival of the winter snow. These plans were unfortunately frustrated by a very serious delay in the shipping of the oxygen cylinders—due, apparently, to the unexpected decision of the shipping authorities in England to classify the cargo as "high explosives." Consequently it was not until early August that the kit reached Kathgodam—whence, after hastily repacking the cylinders into loads suitable for coolie transport, the expedition started in pouring rain on August 8.

This unfortunate delay at the start involved the complete abandonment of Dr. Kellas' plans for comparative observations on acclimatization *en route*, and the paramount consideration now became that of pushing forward with all

* 'General Report on the G.T. Survey of India during 1874-75.' I have searched the original plane-table sections of this area in vain in the hope of discovering the exact site of this fixing.

possible speed in the endeavour to reach the high ground before the onset of winter conditions; leaving the comparative observations for the return journey. Travelling *viâ* the rolling hills and fertile stuffy valleys of Kumaon, we reached Joshimath on August 22, and Niti five days later. Here we halted for a day to arrange for food supplies and for permanent coolies and yaks for our further progress.

Resuming our journey on the 29th with a retinue of twenty-four yaks and forty coolies, we encountered our first obstacle on the following day in the shape of the unfordable Dhauli river, which separated us from the Raikane valley at the confluence of the latter river. This necessitated a day's halt while the coolies constructed a cantilever bridge, the timbers for which had to be fetched from the tree-zone below Niti.

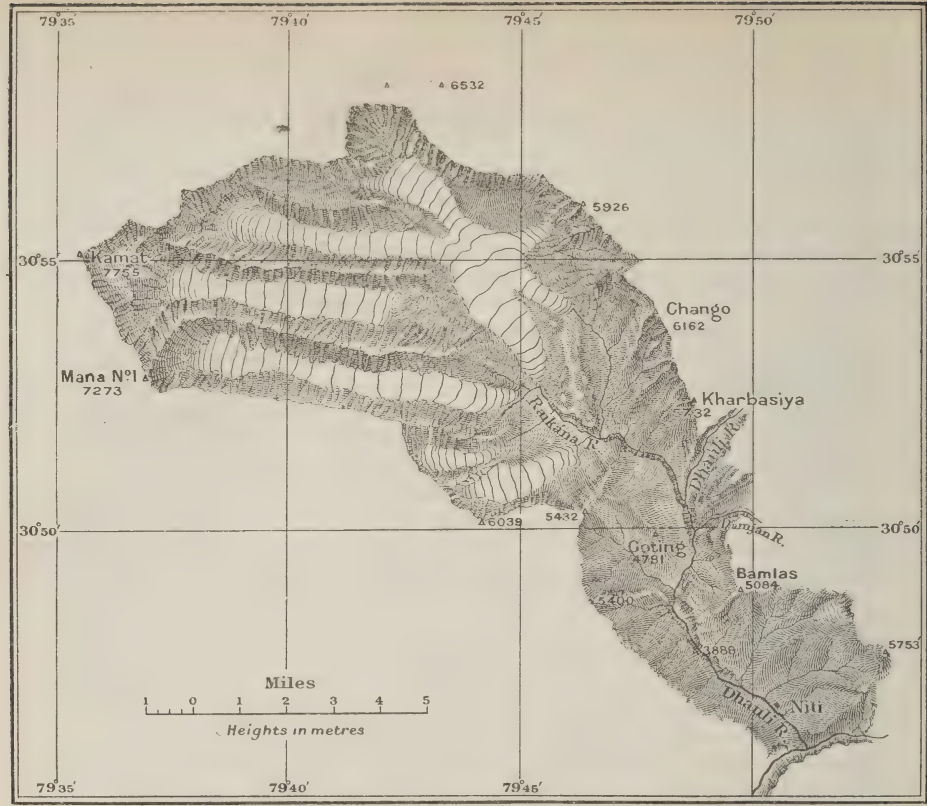
The foot of the Raikane glacier was reached on September 1. Dwarf juniper scrub (*bhitaru*) grows plentifully in this neighbourhood and forms an excellent fuel, which can be pulled up by hand by the roots without the use of an axe, and burns with a pleasant aromatic odour. Above this point no further fuel occurs, nor is the valley passable for yaks. We accordingly made this our base camp (15,380 feet), and determined on a brief halt, in which survey operations and scientific observations could be carried on, while the coolies collected a reserve of fuel for our needs on the mountain. The yaks meantime returned to Niti for fresh supplies of provisions.

Marmots abound in the Raikane valley, and some excitement was caused on our first arrival at the base camp by one of my khalasis catching a tailless "mouse-hare" in his hat. The alpine flowers on the hillsides made a striking and memorable display in their brief autumn glory—edelweiss, fleshy-leaved saxifrages, blue cranesbill, yellow and orange ranunculus, and dwarf primula being among the commonest and most conspicuous.

The thermometer at this altitude usually registered 6 or 8 degrees of frost each night, while the morning spectacle of a powdering of fresh snow covering the hillsides down to 16,000 or 17,000 feet served to remind us that winter was at hand, and that our sojourn on the higher slopes must perforce be brief.

From the Raikane base camp our route was identical with that of C. F. Meade in 1913, and led over the moraines and crevasses of the east Kamet glacier for a distance of 10 miles. Frequent and terrific avalanches from the steep southern and western faces of the valley are a feature of this portion of the route, and form a danger to incautious travellers ; safe camping sites may be found, however, here and there on the opposite side of the valley. We were fortunate in having with us some of Meade's old coolies, whose knowledge of previous camping-grounds proved invaluable, and I am glad to take this opportunity of acknowledging our indebtedness to his gallant pioneering. Profiting, however, by Meade's experiences of mountain sickness after a series of long and rapid marches, we decided on adopting a programme of short and easy stages with frequent days of halting for acclimatization, which latter incidentally enabled the coolies to return for further supplies of much-needed fuel and provisions. Advancing in this manner, on September 10 we reached a camping-ground at 18,460 feet, beyond which the route leaves the main glacier and ascends a steep side valley.

The only incident worthy of mention in this portion of the trip was the loss of two live sheep by slipping through the thin mantle of snow which concealed one of the numerous large crevasses of the glacier. Two and a half days later we managed to lower a coolie by a rope 40 feet into the crevasse, whence he succeeded after half an hour's work with an ice-axe in releasing the two sheep,



The Kamet Glaciers from Sheet 19, 1 inch to mile, Survey of India, 1878

The Kamet Glaciers as surveyed 1920 by Mr. Laltan Khan

which were hauled to the surface—one still alive, and one reduced to frozen mutton.

On September 11 we advanced a further 2 miles and pitched a light camp on rock at a height of 20,620 feet. The majority of the coolies showed signs of distress and complained of violent headaches on arrival at this altitude; we accordingly sent them back to the last camp, keeping only two as guides for the 600 feet of rock climbing which lay ahead. After a day's halt for acclimatization we successfully reconnoitred the rock face on the 13th, finally emerging at the top on to a smooth dome of glassy ice, up which we had time to cut forty-five large steps before returning to camp—a delightful day of real mountaineering.

Next morning the thermometer recorded 28 degrees of frost, while the small patch of rock around our tents was white with freshly fallen snow. Both Kellas' and my own servants were at this period completely *hors de combat* from the effects of the cold, and we had the greatest difficulty in preparing ourselves any cooked food. The daily convoy of provisions and firewood ceased to function in the absence of responsible superintendence at the various posts on our line of communication, and this in turn reacted on the spirits of our coolie guides, who became extremely despondent regarding the prospects of any further progress at this late season of the year.

Our position was manifestly too precarious to warrant any further advance pending an overhaul of the line of communication, and this I accordingly undertook at once. Retracing my steps down the valley on the 15th, I installed my own private servant, who now showed signs of convalescence, as commander of the Raikane base camp, with orders to institute a regular system of *chalans* or invoices notifying the daily number of loads of fuel and stores despatched. Dr. Kellas' servant took charge of the forwarding arrangements at No. 1 camp (16,915 feet), and Mr. Laltan Khan at No. 2 camp (18,460 feet).

This accomplished, I rejoined Dr. Kellas at camp No. 3 on September 17, and found that he had meanwhile got his two coolies to complete the thirty-five more ice-steps required to negotiate the difficult ice at the head of the rock-cliff. After waiting one day to ensure the arrival of the minimum necessary reserves of supplies, we advanced with very light kit and pitched our small single-fly tent on snow at 22,000 feet. Owing to sickness the number of coolies was now reduced to eight, who consequently had to descend again for the night to camp No. 3, returning next day with a second tent (for themselves) and a small supply of ready-cooked food. It was impossible to get firewood carried up the difficult rock-face which separated us from the camp below; both we and our coolies were dependent on food sent up ready cooked from below, aided by such cooking as could be done by a spirit stove in the shelter of the tent. The thermometer next morning registered a minimum night temperature of 15° below zero on the surface of the snow, and our blankets were as stiff as boards where one's breath had congealed on them. Rising from our beds on the snow was consequently more than the work of a moment. However, after heating ourselves a tin of soup on the spirit stove and thawing sufficient snow to fill the thermos flask with bovril, we started forward at 9 a.m.—our two selves and three coolies on the rope. Taking the lead in turns, and steering a winding course to avoid the giant crevasses, we gradually emerged on to the wide flat valley which separates Kamet from E. Abi Gamin. On our left the summit of Kamet showed clearly 2000 feet above us, connecting with the valley by two well-defined arêtes of easy slope, either of which must have been easily climbable had time permitted. It was now 3 p.m., however, and our coolies were dead beat, so after

a brief halt for food and a round of photographs we had to turn regretfully homewards from Meade's col, in order to avoid being benighted. The view from this col is magnificent, comprising the whole Tibetan portion of the Sutlej valley to the north, while 100 miles to the east-south-east the stupendous *massif* of Gurla Mandhata towered head and shoulders above the intervening army of lesser ranges.

Had we been able to induce the coolies to carry our camp one march further forward to the flat open *névé* near Meade's col, it is hard to believe that anything could have prevented our reaching the summit. Lack of properly cooked food, combined with the intense cold, had however undermined the stamina of the coolies, who absolutely refused to carry forward any further loads. My period of deputation had nearly expired, and realizing with regret that the season was now too far advanced for further efforts, I reluctantly bade good-bye to Dr. Kellas on September 22 and turned my steps towards home, reaching Dehra Dun by double marches on October 15—precisely two months from my date of departure.

Dr. Kellas, with Mr. Laltan Khan, remained a further month in Garhwal, and succeeded in completing the essentials of his scientific work, which form the subject of a separate report.

The fact that neither Dr. Kellas nor myself suffered the slightest discomfort at any time from mountain sickness, seems to indicate that our method of attack by a process of gradual acclimatization is correct. That it is essential also to avoid undue fatigue is shown by the fact that our coolies who were carrying daily loads suffered considerable discomfort from the effects of altitude.

It may be profitable to discuss briefly the reasons of our failure to reach the summit of the mountain. Undoubtedly the first and foremost cause was the lateness in the year, due to the unfortunate and unforeseen delay in the arrival of the oxygen cylinders from England.

A second cause lay in the failure of the Survey khalasis, recruited from the middle Himalayas, to stand the climate and altitude of the higher ranges. I had enlisted a dozen strong Garhwali khalasis, with the double object of forming a *corpus vile* for the scientific observations of Dr. Kellas, and of providing a *corps d'élite* of porters for the higher altitudes. With the latter object in view they had been lavishly equipped with warm clothing on the arctic scale. Unfortunately, one half of their number succumbed to mountain sickness at 15,000 feet, while the other half proved so extravagant of our precious firewood that they had to be sent back to the base camp, and their places taken by the hardier Bhotia men of Niti and the neighbouring villages. The provision of boots and warm clothing for the latter on the spur of the moment was however a matter of difficulty, and proved a direct contributory cause of our failure.

A third cause of failure must be traced to the inadequacy of our arrangements for cooking at the higher altitudes. I was unaware until too late that the large Primus stove, on which I had been relying, would not work in the rarefied atmosphere of 20,000 feet, beyond which point methylated spirit is the only possible fuel ; while Dr. Kellas had only one small spirit stove which took an hour to thaw sufficient snow to fill a teapot. Had our equipment included a dozen large spirit stoves and two or three two-gallon petrol-cans full of methylated spirit, both our own and the coolies' cooking would have been assured.

I have nothing but praise for the Bhotia coolies of the higher Himalaya.

On rock they can climb like goats, while on ice they readily learn step-cutting. It appears very doubtful if the present-day expense of importing Alpine guides can ever justify their employment in future Himalayan exploration.

The oxygen apparatus forms the subject of a separate detailed report by Dr. Kellas. Neither of us felt the slightest need for artificial stimulants in the form either of oxygen or alcohol up to the highest point reached, and my impression is that one could have gone several thousand feet higher without distress of breathing, had other conditions admitted. On the other hand, the handicap of 15 lbs. additional weight of oxygen cylinder on one's back, supported by a system of tight belts and straps, proved more than I for one could cope with.

I obtained a special blue print on drawing-paper of the old 1-inch to the mile Sheet No. 19. This was mounted on a light 20″ × 20″ plane-table for Laltan Khan's use, 115 square miles of country were revised and contoured in modern style, disclosing considerable discrepancies in the old reconnaissance surveys. Roads, streams, and watersheds were found sometimes as much as ¾ mile in error, while the original surveyors had evidently never visited the upper portions of the Raikane and Kamet glaciers.

It only remains to express my gratitude at being privileged to serve my apprenticeship in mountaineering under so experienced a hand as Dr. Kellas. Failure is often more instructive than success, and I can only hope that this expedition, on which I shall always look back with feelings of pleasure, may be the prelude to other more successful future efforts in the same genial company.

DE SAUSSURE: REVIEW

The Life of Horace Benedict de Saussure.— **Douglas W. Freshfield, D.C.L.,** with the collaboration of **Henry F. Montagnier.** London: Edward Arnold. 1920. 8vo. Pp. xii., 465. *Portraits, Illustrations and Sketch-map.* 25*s. net.*

IT is remarkable that, although we have endless lives of minor men, the life of de Saussure awaited a biographer; for de Saussure was by no means either a minor man or a man whose activities would appeal only to a special public. A great mountaineer, a distinguished scientist, an educational reformer, the central figure in a distinguished society in Geneva during the last half of the eighteenth century, and finally a kindly gentleman—the life of such a man, if sufficient material has survived, should be interesting reading. Fortunately, the material has survived and been collected, and Mr. Freshfield has produced a book of which he should be proud. For many years he had contemplated writing the life of de Saussure. From time to time, however, he was deterred by the difficulty of collecting all the material necessary, for researches had to be made among the family papers and public archives in Geneva and elsewhere. This difficulty was at last overcome by the kindness of Mr. H. F. Montagnier. "Mr. Montagnier, finding himself resident in Switzerland and debarred from active service during the Great War, has at his own suggestion employed his leisure in ransacking public libraries and obtaining access to private collections in quest of material bearing on de Saussure's career—scientific, Alpine, political, and social."

Mr. Freshfield's life of de Saussure is the result of many years' study. It has been written because he was keenly interested in the subject, and he has taken every care that it shall not be merely a collection of facts. As one

reads the book one feels that the characters in it are all alive. First, de Saussure himself, with his thoroughness, his fairness, his amiability, and his self-restraint in his treatment of Bourrit, who must have often irritated him. Even Bourrit one has a liking for, in spite of his mischief-making. His pluck and enthusiasm for the mountains and his courage of his opinions has our kindly recollection. And there is the famous Dr. Tronchin, a most delightful and wise man. He ridiculed all the antiquated medical systems and the violent remedies in vogue. "His favourite prescriptions were moderate diet, pure air, country life, riding; above all, out-of-door exercise." The genial doctor could give good advice as well; in a letter to de Saussure (1775) he says, "Add to your virtues that of bearing contradiction; this virtue is far more necessary in republics than monarchies; it is the safeguard of peace of soul and tranquillity of mind—conditions which perhaps are not held at their proper value in republics." One can imagine the old doctor chuckling as he wrote it. Charles Bonnet also seems to have had a sense of humour. The Emperor of Austria was travelling from Geneva to Lausanne, and would pass through Ferney where Voltaire lived. "The Emperor," Bonnet writes, "passed through Ferney like an arrow. The old gentleman (Voltaire), with all his household in full dress, was waiting for him. He had got up early and worn his best wig since eight in the morning. Nevertheless the Emperor did not halt for a single instant, and even when the postilion indicated Ferney the Emperor only shouted twice over, 'Fouette, cocher!' It is clear that he intended to mortify the old pamphleteer, who, I assure you, felt it deeply." And there are many others one reads about who were excellent folk, and who formed part of the interesting society in Geneva in those days.

Mr. Freshfield has divided up the life of de Saussure in a manner that adds greatly to the pleasure of reading the book. He has not taken it year by year, which would have meant that the very different activities of de Saussure would have been disjointed as far as a narrative is concerned. He gives us first, chapters on de Saussure's youth and early travels; then six chapters on de Saussure's Alpine travel: the ascent of Mont Blanc and visits to various parts of the Alps; finally, he deals with politics at Geneva, de Saussure's home life and connection with science and literature.

De Saussure was born in 1740, and died in 1799. The background against which his figure must be set was one of change. In his youth Geneva was a centre of intellectual thought and activity. Then came the petty quarrels of the Genevese and the final wreck of their ancient republic. All through these troubles de Saussure played a prominent part, always brave and always wise, always patriotic, and a part that, as Mr. Freshfield points out, has not been adequately recognized by local historians. The Genevese have sadly neglected one of their most famous citizens; they have left the story of his life unwritten for one hundred and twenty years, to be finally told by one of another nation; and they have not even put up a tombstone over his grave.

De Saussure was of an old patrician family who in the middle of the sixteenth century came to Geneva as religious refugees. Even as a boy he showed that he had ideas of his own, and he was always fond of weekly tramps, during which he explored many of the lower mountains near Geneva.

It was about this time that de Saussure came in contact with Albrecht von Haller, a botanist who wrote a work on the alpine flora. Sainte-Beuve describes him as "the Hercules of Physiology, a robust and athletic savant, opinionated, active, ambitious and versatile." He had a European reputation that was hardly deserved. It was de Saussure's uncle, Charles Bonnet, who brought

de Saussure and Haller together. Charles Bonnet was at that time one of the leading names in science and philosophy at Geneva. Both these remarkable men strongly influenced the young de Saussure. In fact, it was Haller who first sent de Saussure to Chamonix, in 1760, to collect plants; it was Bonnet who urged him to adopt an active scientific career.

Two years later de Saussure was elected a Professor at the Academy, that of Philosophy. In those days Philosophy was a large subject for a young man of twenty-two to lecture on. "It was held to include Psychology, Logic, Morals, and Divinity, also the general principles of the Natural Sciences, with some acquaintance with the views of Bacon, Descartes, and Leibnitz." At any rate, the arduous duties of the Professorship did not prevent him in 1768 from obtaining leave of absence from his duties and setting out on a grand tour with his wife, whom he had married three years earlier. He visited Paris, Holland, and then crossed over to England. From London they travelled north to York, where they attended the races, afterwards visiting many of the chief towns and houses in the north of England: Sheffield, Manchester, Birmingham, etc. De Saussure then visited the mines in Cornwall, also Oxford and Cambridge, before he returned home after an absence of a year. He writes to his sister, "I am leaving England with regret; I found so much that was of interest for my pursuits, that had not a tenderly loved father and mother, dear children, and a country which after all has its attractions, called me home, I do not know how I could have returned." In 1771 he made his first visit to Italy. But undoubtedly the most interesting of de Saussure's travels were those to the Alps, that culminated in 1787 in his ascent of Mont Blanc. As far back as 1760 de Saussure had offered a reward to the first man to climb Mont Blanc, but no serious efforts were made to take advantage of his offer for many years after. In 1770 it is true that "visitors to the glaciers" became more frequent, and Mont Blanc was becoming famous. Naturally, therefore, the idea of making a determined effort to ascend the mountain was being taken seriously by several people who were capable of accomplishing the ascent. De Saussure had always been anxious to stand on the summit of the highest mountain in Europe. But there was another enthusiast, Bourrit, whose passion for the Alps took possession of him as far back as 1757. Moreover, Bourrit lived at Chamonix, and after about 1783 he made many unsuccessful attempts on the mountain. In the history of the first two successful ascents of Mont Blanc we find the names of these two men on almost every page, and although neither of them was the first to conquer the mountain, they occupy the stage more than Dr. Paccard, who with a guide, Balmat, carried away the prize in 1786. De Saussure made the second ascent one year later, and poor Bourrit, who tried time after time, never was successful.

As in all great enterprises, when there are several competitors in the field, there is usually one who cannot take defeat philosophically. In this case it is Bourrit. Mr. Freshfield has collected so many interesting letters, written by the people concerned in the attempts to climb Mont Blanc, that one is able to judge with accuracy the rights and wrongs of the controversy as to the merits of all. Dr. Saussure behaves all through like a gentleman. Bourrit, although a genuine enthusiast for the mountains, is overcome with jealousy, and tries to belittle the achievements of those more successful. We find de Saussure as the peacemaker.

The first real attempt on the mountain that might have been successful was in 1784 by Bourrit; his guides reached the rocks below the Bosses, where the Vallot hut now stands. They had, however, to leave Bourrit far behind at the

foot of the first rocks below the Aiguille de Goûter. The next expedition was in 1785, by de Saussure. Bourrit was included in the party, and it was apparently due to him that they failed to climb as high as the guides had done a year previously. De Saussure, however, merely remarks that he is resolved never again to admit companions on a glacier expedition. But the time was fast approaching when the giant was to be conquered. The credit is due to one man alone, Jacques Balmat. He was not one of the ordinary guides. Whilst alone on the mountain he satisfied himself that he had discovered a possible route, and if he could attempt it with some one who could be trusted not to make any claim to a share in the promised reward, he meant to climb to the top of Mont Blanc. Such a man was Dr. Paccard of Chamonix. On 8 August 1786 these two men, after a climb of fourteen and a half hours, stood together on the summit of Mont Blanc. De Saussure made the second ascent in the following year. It is shortly after this that Bourrit first appears as a mischief-maker, and his jealousy and vanity led him to action that later he must have regretted. He insinuated in a letter to de Saussure, that the point reached might not be the real top of the mountain; he then asserted that he was the real explorer of Mont Blanc; again, that all the credit was due to Balmat, and represented that Paccard had been forcibly dragged to the summit by his companion. It was de Saussure who had to remonstrate with the disappointed Bourrit, and pour oil on the troubled waters. But for long after this Bourrit did not cease from troubling.

Although naturally the conquest of Mont Blanc was put before all others, de Saussure did not neglect other parts of the Alps. Probably he covered more ground than any other Alpine traveller of his time. In his 'Voyages dans les Alpes' he records seven separate journeys: he visited the Oberland, Monte Rosa, and crossed many passes. From the Splügen to the west of Mont Blanc he wandered far and wide through the mountains; his enthusiasm for them must have been great, for he had a delicate constitution and he never enjoyed really robust health. But de Saussure was a many-sided man. He climbed mountains as a means for scientific research, as well as for the pleasure of the climb; also he was always able to appreciate their natural beauties.

One evening at a rough cabin at the base of the rocks of Aiguille de Goûter he tried to make various experiments; unfortunately, his boiling-point thermometer proved a failure. "But," he writes, "the beauty of the evening consoled me for this disappointment. The evening vapours, like a light gauze, half hid the vast expanse under our feet, forming a belt of the most beautiful purple, while to the east the snows of the base of Mont Blanc, illuminated by the rich glow, offered a singularly magnificent spectacle. As the vapour fell lower and condensed this belt grew narrower and deeper in colour until it turned blood-red, and at the same moment little clouds which rose above it threw out so vivid a light that they resembled stars or flaming meteors." Another time, in the 'Discours Préliminaire,' he writes of the mountain, "Thus the view of these grand objects engages the Philosopher to meditate on the past and future revolutions of our globe. But if in the middle of these meditations the idea of the little creatures that crawl on its surface crosses the mind; if he compares their duration with the great epochs of nature, how much must he wonder that, occupying so little space both in place and time, they should have been able to imagine that they were the sole end of the creation of the universe, and when from the summit of Etna he sees under his feet two empires that in other times nourished millions of warriors, how puerile must ambition appear to him! It is there that the Temple of Wisdom should be built, in which to repeat after the bard of nature, 'Suave mari magno.'"

Although during the eighties of that century de Saussure went to the mountains whenever he could, yet the clouds were gathering fast for the tempest that swept away the old Genevese constitution. To quote Mr. Freshfield: "The three main dates to remember in Genevese politics as they affect the life of de Saussure are 1763–6, the period of the protracted struggle of the democratic Assembly against the aristocratic Councils, ending in some advantages for the former; 1782, the oligarchic reaction, when the Councils by aid of the mediating Powers recovered more than they had lost; and 1789–94, the years of revolution, culminating in the abolition of the old constitution of the State, and finally in 1798 in the annexation of Geneva by the French Directory."

All through these troublous times de Saussure played a strenuous and persevering part, always honest, wise, and brave. But he could not save the State for which he had done so much. The trouble and worry undoubtedly killed him, and he died in January 1799, insolvent.

De Saussure's life was full of the most varied activities, and he had a mind that was an open one and that saw far. Even in early life we find him making a forcible appeal to his fellow-citizens to prepare for the future by reforms in education. In the study of geology he contributed largely to the stock of ascertained fact, and practically gave the word "geology" to science. He insisted it was the study that taught us the past history of the globe. Sir A. Geikie writes of him: "De Saussure was the first and most illustrious of that distinguished band of geologists which Switzerland has furnished to the ranks of science." As a literary man he produced amongst other works the 'Voyages dans les Alps,' he insisted on the movements of the glaciers, he collected plants and minerals, and he has given us a valuable account of the wild recesses of the Alps, as they were one hundred and fifty years ago.

Mr. Freshfield's 'Life of Horace Benedict de Saussure' is a delightful book. He is to be congratulated on having written a real life, where the characters live again before our eyes, and Mr. Montagnier also has our thanks for having supplied so much invaluable material. Through the pages flit all sorts and conditions of interesting folk. Rousseau, the old "pamphleteer" Voltaire, Gibbon, the jovial Dr. Tronchin, Bourrit (who lived to the age of eighty, dying in 1819), Charles Bonnet, Haller, Madame d'Epinay, Madame Necker, Madame de Staël, and many others whom he met on his travels.

The book appeals to the widest circle of readers. The letters are so delightfully translated into English that one forgets that they were originally written in another language, and the story is told so easily that one never feels inclined to skip a page. Amongst biographies Mr. Freshfield's life of de Saussure must take a high place. It gives us a most interesting insight into the life of Geneva during the last half of the eighteenth century, and side lights on society in France, Italy, England, and elsewhere.

The complete history of the conquest of Mont Blanc is told for the first time as a connected whole; also we learn much about the state in those days of the sciences botany, meteorology, and geology.

But the chief merit of the book lies after all in the fact that, unlike most biographies, it leaves one with a feeling that for once a really true account of a man's life has been written. De Saussure stands out amongst lesser men, on the one hand, as a patrician of the old school, and on the other, as a man who could also understand the aspirations of the new. It is sad that in his old age he fell on evil days. He had conquered Mont Blanc, but the folly of the folk of his own town he could not conquer. He failed in the attempt, and it killed him.

J. Norman Collie.

MOUNTAINEERING: REVIEW.

I. **Mountaineering Art.**— **Harold Raeburn.** Fisher Unwin. 1920. Pp. 274. *Price* 16*s. net.*

II. **Mountain Craft.**— Edited by **Geoffrey Winthrop Young.** Methuen. 1920. Pp. 603. *Price* 25*s. net.*

THESE are the only books of importance which have been published in English on the Art of Mountaineering for nearly thirty years, and they have appeared almost simultaneously. Both are books to be studied at home; for even Mr. Raeburn's is rather heavy for light luggage, while Mr. Young's is obviously a book for the armchair. The latter is a very comprehensive work, and includes chapters on Mountaineering in the Tropics by Mr. Wollaston; in the Arctic by Sir Martin Conway; in the Caucasus by Mr. Raeburn; in Corsica by Mr. Finch; in the Himalaya by Dr. Longstaff; in Norway by Mr. Slingsby; in New Zealand by Mr. Ross; in the Pyrenees by Mr. Elliott; and in the Rockies by Mr. Mumm. There is also a chapter on Mountaineering on Ski by Mr. Arnold Lunn, and one on Mountain Photography by Mr. Sidney Spencer; and there is lastly a chapter by Captain Farrar, assisted by Mr. Eckenstein (Ropes and Knots) and Miss Jones (Ladies' outfit), on Equipment. Obviously the editor is to be heartily congratulated on having secured the assistance of collaborators, none of whom could be bettered, and few of whom could be equalled in expert knowledge of the subjects on which they write. Some of these chapters are better than others, but space forbids more than the mere enumeration. Of the 600 pages about 400 have been written by the "Editor," who is really the "Author" of the book according to its title, and the conceiver of the wider scope which renders it complete.

So it comes to this, that Mr. Young has written about 400 pages, while Mr. Raeburn—who has also secured female assistance when confronted with the problem of feminine attire—has written about 260. Yet it is perhaps in the shorter book that the novice wanting advice on any point may come at it more readily and find it treated as adequately, though in quite a different way. And, looking at the two books in the large, the essential difference in method of treatment probably lies in the fact that Mr. Raeburn is a practical downright Scotchman, while Mr. Young is, at the back of everything, a poet. Some of the headings convey the idea—Mr. Young's "Collective Rhythm" for instance, contrasting with Mr. Raeburn's "Combined Tactics"; but the difference perhaps comes out best in the opening sentence of each book, and, though Mr. Young can be as short-cut and practical as any one in enforcing his instructions, it permeates the atmosphere of both books throughout. Mr. Raeburn's first sentence reads thus, "Mountaineering is the art of getting up and down mountains"; Mr. Young's "This book is for mountaineers: and a mountaineer is not only one who climbs mountains, but any one who likes to walk, read, or think about them." And, whatever one's opinion of the definition, one likes to read Mr. Young, and certainly he often makes one think. And so, too, does Mr. Raeburn, for both books advocate many novel views and practices, some of which must give cause to ponder among the elders, accompanied perhaps with here an opening of the eyes, and there a shaking of the head. But both authors will take most of the youngsters along with them, while the old stager will find much to approve and something fresh to learn from both works.

The space at our disposal is much too limited to allow of anything like a full report or criticism of the books considered as technical guides to the Art

of Mountaineering—which is their aim. The questions of weather, state of the snow, reconnoitring, pace, food, length of expeditions, huts, bivouacs, accidents, precautions, emergencies, and a host of similar matters would require many pages of comment, and many more might be written on the detailed instructions referring to the advantages and disadvantages of divers knots, bights, and bends, of the subtleties of rock climbing, of step-cutting, and of glissading, on which last point Mr. Young holds almost Utopian ideals. In his index there are twenty-three sub-heads, and there are twenty-one pages of text, while Mr. Raeburn devotes five pages to the same subject. Indeed, it would appear to the reviewer, whose experience in this field is by no means negligible, that some of the attitudes and devices advocated may perhaps have been discovered in unorthodox ways. The margin between sliding and slipping is sometimes a narrow one, especially when a patch of unexpected ice replaces snow. And there is art too in recovering from obvious slips, as our authors point out elsewhere: for the question of slips and tumbles, and the risks connected with avalanches, cornices, crevasses, rotten rocks, falling stones, blizzards, thunderstorms, and other aspects of what Mr. Young calls "Mountain Perversity" and "Evil Weather" and Mr. Raeburn refers to under more prosaic headings, are treated, in many cases, as generously as is glissading.

Obviously adequate criticism is impossible, but a few random points may be selected for a word or two. Both authors emphasize the importance of the training to be got in our own island: both agree in the competence of the best amateur guides of to-day: both have a word to say in favour of the oft-abused party of two (though Mr. Young allows it only on the rocks); while Mr. Raeburn has the temerity to excuse his well-worn vice of climbing alone if he cannot find a suitable companion. Both agree on the advantages of smallish boots with narrow soles and lightish nails, and on many other technicalities, while on some they differ; and yet there exist certain modifications of crampons, axe-slings, and other niceties, much prized by their advocates as "the best," which both authors fail to mention. But it is not easy to find anything of importance which is not adequately treated in either volume.

One point in Mr. Raeburn's book must not be left unnoticed—his two synthetic climbs, ingenious, instructive, and realistic: the one a picture of a "moderately difficult" British rock climb, and the other of an Alpine expedition of average, or rather over-average, difficulty. His brave advice to eat snow freely when thirsty and drink not available deserves mention; and one may add the criticism that if he inserted a glossary at all, he might well have produced a complete one, for one is wanted, as the best pre-existing are admittedly defective.

To the reviewer the weakest point in both books appears to lie in the illustrations: and indeed, beyond the photographs of knots, Mr. Young's book can hardly be said to be "illustrated" at all, though he would probably contend that the half-dozen beautiful photographs of snow, rock, and sky do illustrate the spirit of his work better than anything else could. The frontispiece is probably an intentional enigma: "What is it? Where is it? What is the best way up?" Probably both author and photographer thought of these things when they selected this picture for the place of honour and labelled it "The Alps."

Mr. Raeburn's book stands quite otherwise. It is freely illustrated, largely with carefully chosen photographs, but the results are in many cases unsatisfactory, possibly on account of the angle from which they are taken. On pages 80 and 111 one sees climbers in somewhat heroic attitudes on slopes

which look mere child's play. The gentleman in a "vertical pose," p. 189, appears to be semi-prone, "while his counterpart "descending a chimney," p. 183, is apparently spread-eagled on an awkward and very flat rock-face. An interesting picture is that facing p. 54, which, like Mr. Young's frontispiece, is an enigma. Who is it? and how did he get there? Surely it is Mr. Arthur Balfour, and if so the mode of approach was probably by aeroplane. But this is a good picture, and so are many others, and the drawings of knots and appliances are irreproachable. Yet with regard to both of these books, how much they miss in not having had a Whymper, or a Willink, or for the matter of that a Compton, to illustrate them!

In conclusion one may say that both of these works will live, and that every Alpine library must possess them. Both are written by masters of their subject, and the labour of writing them has obviously been a joy to the authors, both of whom possess the power, in very different ways, of conveying their enthusiasm to the reader. C. W.

REVIEWS

EUROPE

Macedonia: a Plea for the Primitive.— A. Goff and **Hugh A. Fawcett, M.R.C.S., D.P.H.** *With Illustrations by* Hugh A. Fawcett. London: John Lane. 1921. 21*s. net.*

The special feature of this book is its long series of really beautiful illustrations, which include four plates in colour and a number of pencil drawings. Many of the latter are of architectural subjects, and one in particular, a view in the Turkish quarter in Salonika, is worthy of special mention. The value of the Salonika drawings is of course increased by the fact that many of the buildings shown must have been since destroyed in the great fire.

Of the text it is more difficult to speak; for, whether on account of the dual authorship, or from some other cause, it seems to lack unity of aim and coherence. The title suggests an impressionist study of the region, and such an assumption seems to be confirmed by passages like the following, which may serve to give a general idea of the style: "Many have lost the power to appreciate the natural wonders of the world, others, engulfed in the soulless pursuit of modern industry or blinded by the glare of civilization, have never had an opportunity. To amend such defects and to enable others to understand the lesson of wild and simple Nature has been, among others, the aim and object of these pages." But in the Introduction, which precedes a "Foreword," we find it stated that "So fortunate were the authors in their combined travels and experiences, . . . that they have been enabled to compile what is believed to be, from a non-political and non-military standpoint, the first detailed description of Macedonia." This is a large claim, even if we suppose that the words "in the English language" are intended to be understood. The Table of Contents suggests further that some attempt at least has been made at completeness, for we have sections devoted to Physical Geography, Products, Industries, the Vardar Wind, the Flora and Fauna, and so forth. But the geographer who, for example, turns up the chapter last mentioned must be prepared for disappointment. "In attempting to describe the plants and flowers of Macedonia one is confronted not only by countless species but by many new and unknown varieties." One is tempted to inquire to whom they are unknown, for Adamović's study of the vegetation of Balkan lands was

thorough enough. Again, we find several pages devoted to insects, and the list of illustrations contains one with the rather intriguing title of "Winged insect, Macedonia." The drawing proves to be a representation of a Nemopterid, with the characteristic strap-shaped hind wings. If it was worth while to include this drawing, it was surely desirable to take the trouble to consult a book of reference or an expert in regard to the insect. These are only two out of many indications that the authors have relied solely on their personal observations, and have not sought to supplement them by study. For an impressionist survey such a course may suffice, but it is dangerous when a "detailed description" is attempted. M. I. N.

The Great Fire of London in 1666.— W. G. Bell. London: J. Lane. 1920. Pp. xii., 387. *Price* 25*s. net.*

It is surprising that no detailed connected account of the Great Fire of London has hitherto been published, all the more so considering the interest shown by the Corporation of the City in the study and publication of its interesting records. This may probably be explained by the fact that such an account could be compiled only by one possessing, besides the other necessary qualifications, an enthusiasm for the antiquities of London. This combination has happily arisen in the person of Mr. Bell, whose former studies of London are well known. His researches and interest have enabled him to give a detailed and graphic description of the origin and spread of the Fire as it raged for four nights and days through the lanes and streets of the City, and to some extent the liberties beyond the walls. Having done this he discusses many incidents and problems arising out of the catastrophe, as for example the outcry against foreigners and papists who were believed by the mass of the people to have been the cause of the fire (a belief perpetuated by an absurd inscription on the Fire Monument), the losses involved, and the schemes for rebuilding the City. After describing and illustrating the plans propounded by Wren and Evelyn for rebuilding London so that it should rise from its ashes as a model city, he gives an account, in a very interesting and informing chapter, of the legislative measures adopted for solving the extremely difficult and delicate problems involved in carrying out any scheme of rebuilding. The Acts passed by the Legislature for the purpose were so just and enlightened that they will come as a surprise to those who have been led to expect little but corruption in the period following the Restoration. A court of Fire Judges, composed of any three or more of his Majesty's Judges, was set up to determine differences. It sat in the Hall of Clifford's Inn, which escaped the fire and still exists. This court was fortunate in having as its chief member the draftsman of the Act, Sir Matthew Hale, of whom it was said, "He was the great pillar of the rebuilding of London. By his prudence and justice he removed a multitude of grave impediments."

The part played by Wren in laying out and rebuilding the new City is discussed at some length by the author, and his conclusions will probably cause some surprise. But he gives good reasons for his belief that it was almost negligible. He comes to the same conclusion with regard to the many Companies' Halls that have been attributed to the famous architect. "Indeed, in all the City to-day," says Mr. Bell, "I know only two buildings (the churches apart) that I should with confidence attribute to Wren." These are the Deanery of St. Paul's and the College of Arms. But regarding the churches it is very different. In addition to St. Paul's nearly fifty churches were built by Wren, and their variety and beauty explain the title given him of Britain's greatest architect.

It was several years before any considerable rebuilding of the City was

accomplished, which shows the absurdity of another inscription placed on the monument to the effect that London was rebuilt and brought back to its former glory in three years.

An appendix contains a number of letters by eye-witnesses of the Fire, including those written in Dutch, Spanish, Italian, and German. The book is illustrated by views, plans, and photographs, and many notes, and concludes with a list of authorities. The author is to be heartly congratulated on bringing to a successful conclusion a work entailing so much time and labour.

E. A. P.

ASIA

Japan, Real and Imaginary.— Sidney Greenbie. New York and London: Harpers. 1920. $4.00 *net.*

Mr. Greenbie's book is mainly based on observations during the early weeks of his short residence in Japan. His impressions are those of an American observer quite well-disposed towards its people. While he is clearly of opinion that their hope of real progress lies in a thoroughgoing Americanization, one great obstacle to this he sees in "the menace of the hydra-headed monster of imperialism."

He writes, with every effort at fairness and sympathy, of the superficial features of the everyday life of the people he saw on the beaten tracks, for his travels and observations were almost entirely confined to these frequented regions. But of the peasantry of the interior, whose industries form still the backbone of Japan's richest resources, and whose numbers constitute more than half the population of the country, he seems to have seen but little. He speaks of the stones laid on shingle roofs on the west coast as a unique method of roofing, whereas it is quite the usual custom all over the Alpine districts of the country.

Imperfect information is responsible for many minor errors, *e.g.* the statement that there are "barely 130,000 Christian converts" gives a figure for the total which is, even according to official returns, little more than *half* the actual number of *adult* adherents alone. The carp flown on the "Boys' Festival" in May are not made of "cloth" but of oiled paper. To describe the shrines of Ise as "shacks" and the splendid temples of Nikko as "garish" is in violent contrast to the sentiments of nearly all travellers who have visited them before this writer. The statement that "Japan is still unconscious of the value of human energy" is an astonishing contradiction of the almost universal feeling and practice of the nation to whom, until sixty years ago, machinery was unknown. The book contains a large number of most interesting and excellent illustrations, and the author's observations on the conditions of prison life and discipline, and of the *Eta* (outcaste) communities are amongst the most valuable portions of the work.

W. W.

AFRICA

The Ila-speaking Peoples of Northern Rhodesia.— Rev. Edwin Smith and (the late) **Captain Andrew Murray Dale.** London: Macmillan & Co. *Two vols. Price* 50*s.*

This study of an interesting and hitherto little-known Bantu people in South Central Africa is likely to establish a standard of what such ethnological studies should be. It reflects the highest credit on its authors: The Rev. Edwin Smith, a Church of England missionary in Northern Rhodesia, and afterwards an Hon. Chaplain to the Forces during the War; and Captain Andrew Murray

Dale, a magistrate in the service of the British South Africa Chartered Co. The Rev. Edwin Smith was already the author of a Handbook of the Ila language published some fifteen years ago, and noted far and wide as a remarkable philological treatise. Captain Dale unhappily died in 1919, before these two volumes saw the light.

The Ba-ila only began to be heard of in the middle of the nineteenth century, when they were mentioned casually by Livingstone as the "Bashikulompo" (Ba-shukulumbwe). F. C. Selous entered their country in 1878, and again ten years afterwards; and Dr. and Mrs. Holub attempted to cross "Bwila" in 1886 when leading the first expedition organized to travel from South Africa to the Sudan. All these early explorations were repelled by the Ba-ila, largely on account of misunderstandings. Then the Ba-ila were taken in hand by Methodist and Anglican missionaries, and twenty years ago British authority was established amongst them by officials of the Chartered Company, who ever since have ruled them wisely and well, from the natives' own admission as well as the statement of the missionaries. Indeed, how well missionaries and lay administrators can work together when both are at one as to "native" policy is shown by this book and its contents.

"Shukulumbwe," the original name applied to this people, is a nickname of the Zambezi people referring to their extraordinary head-dress. Ba-ila, or Ila, is the right designation. In language they are exactly on the border-line between the Eastern and Western Bantu. Their tongue (as to the elucidation of which and of its neighbours I have been greatly helped by the Rev. Edwin Smith and the officials of Northern Rhodesia) is grouped by me with Lenje, Tonga, and Subia, and is illustrated in its affinities in the first volume of my 'Comparative Study of the Bantu Languages' (No. 78). Physically speaking the Ba-ila, or the inhabitants of the Bwila country in the central basin of the Kafue River, consist of three main types: (1) the good-looking, finely proportioned "aristocratic" type, very much akin in appearance to the cattle-keeping Bantu of Tanganyika; (2) the "brutal" Negro type; and (3) the Luba race. The Luba type is unmistakable, especially among the men. (It has been well illustrated by Emil Torday.) There is usually rather a full beard and the facial features are somewhat refined, recalling those of the Gala and Arabs, though the skin colour is black. Whether the full beard is due to any Portuguese intermixture during the three hundred years of contiguity with Angola it is difficult to say. More likely it is due to the intrusion in prehistoric times of some Negroid race from the north-east associated with the ancient copper workings.

The indications of "pre-history" in Bwila are sketched in chapter ii. They contain suggestions of great interest, which it is to be hoped will be followed up by careful investigation. Every phase of this Ila people is dealt with. The question is often raised as to the benefits derived from missionary intervention in Africa. Here, as in inner Congoland and parts of West Africa and Equatorial Africa, you have the answer. The missionaries at least intervene to secure decent treatment for the girls and young women. The authors of this book have been wise in stating plainly, even if they have to make use of Latin to do so, the licentiousness of an interesting people which was like to become a cause of their decline and proximate extinction. I have only one fault to find with the book—it perpetuates two South African mistakes in spelling: Zambesi and Matabele. It has been pointed out long ago in this *Journal* that Zambezi and Tebele (Ma-tebele) accord most with the etymology and pronunciation.

H. H. JOHNSTON.

AMERICA

A Cheechako in Alaska and Yukon.— Charlotte Cameron, O.B.E., F.R.G.S. London: T. Fisher Unwin. 1920. *With a Map and* 36 *Illustrations. Price* 25*s. net.*

Mrs. Cameron made a tour to Alaska during the summer months, presumably in 1919. After calling at Ketchikan, Wrangel, and Juneau, the steamer took her to Skagway, whence she had a comfortable journey by rail over the White Pass and by steamer to Dawson. Thence she descended the Yukon to Old Hamilton, making an excursion up the Tanana on the way, and passing St. Michael came to Nome. She describes her varied experiences in a light and agreeable style, interspersed with many anecdotes and scraps of information of all kinds. She also took great interest in the mining industry (of which she gives some statistics), furs and fox-breeding, fishing, reindeer, the Eskimo and their productions. The book shows that the chief routes of Alaska can now be followed with comparative comfort, and that, in summer at least, travelling there is pleasant and interesting. Mrs. Cameron speaks enthusiastically of the great resources of Alaska, and predicts for it a brilliant future. But the country is still in its infancy, and at present it is impossible to tell whether some of its industries can be profitably developed. W. A. T.

AUSTRALASIA AND PACIFIC ISLANDS

Islands Far Away.— Agnes Gardner King. London: Sifton Praed & Co. 1920. Pp. 256. *With* 67 *Illustrations by the authoress, and* 2 *Maps.* 18*s.*

Not since Miss Gordon Cumming's fascinating 'At Home in Fiji' saw the light, now forty years ago, has the reading public been treated to any kindred book of such singular charm as this one by Miss King. Her journey, whereof she made Fiji the principal objective, was undertaken in serious quest of bodily and mental refreshment, after a period of great strain. It had nothing whatever in common with the jaunts of a globe trotter or bookmaker. The present volume is indeed, as Sir Everard im Thurn points out in a valuable introduction he contributes to it, "entirely an afterthought"—one, it may be added, which has only assumed shape eight years after the event. The journey was shared by a competent guide and companion, whose foreknowledge of the Fijians, their language, and their glorious islands had been acquired during long years of residence amongst them. The travellers roamed on foot and by canoe through some of the most remote and interesting districts of the highlands of Na Viti Levu; besides visiting many other places, including Samoa, Vavau, and Tongatabu, in more civilized fashion, but briefly.

Miss King's wonderful grasp of the natives' mentality and "vein," and her gift for spontaneously convincing them, particularly the womenfolk, of her ready and genuine sympathy with their family and domestic life, will be clear to every reader who knows the Fijians thoroughly from long experience, and no less to the untravelled dilettante who takes up the book. Easy as it is to gauge the interest and praise the merit of it as a whole, difficulty arises if one essays to adjudge the palm between Miss King's text and the admirably natural drawings with which she has adorned it. Filled with artistic perception, and attuned to the sentiment of the situation and people, she has cleverly managed to catch with the brush, and represent with the pen, some of the most attractive features of the scenery and people among whom she stayed. But the book must be read to be appreciated as it deserves, and may confidently be commended from every point of view. It seems ungracious to

criticize; but amidst so much that is good surely a better likeness of the handsome and genial Andi Thakombau than the figure at p. 116 might have been achieved? B. G. C.

MATHEMATICAL GEOGRAPHY

Geodesy.— G. L. Hosmer. New York: John Wiley & Sons; London: Chapman & Hall. 1919. Pp. 368. *Diagrams and Illustrations.* 18*s.* 6*d. net.*

Any book on surveying written by Prof. Hosmer is sure of a welcome, and geodesy is a subject in which there is plenty of room for a really good text-book. It is a little disappointing however to discover that we have here a book on advanced surveying rather than on geodesy pure and simple. Geodesy is not an easy science to define—Prof. Hosmer limits it to investigations of the form and dimensions of the Earth—and yet, in the course of no more than 360 odd pages, he touches on such matters of detail as theodolite and level adjustments, and includes chapters on least squares and map projections. On the other hand, we look in vain for the mention of the early history and development of geodesy, and are told little of the practical arrangements and organization of those large trigonometrical operations which have given to American geodesists so much food for investigation.

I doubt therefore if it will prove a favourite with such British surveyors as have anything of a survey library, in spite of the real interest of such chapters as do deal with geodesy.

The chapters on triangulation, base measurement, and astronomical observation call for no particular comment. The instruments and methods described are those of the Coast and Geodetic Survey, and the more precise side of observation and computation is, naturally, emphasized. After these opening chapters comes the geodetic portion on the properties of the spheroid, calculation of geodetic positions, figure of the Earth, gravity measurements, and precise levelling. These constitute a clear and valuable theoretical *résumé* of the subject. Unfortunately it is given in very condensed form, and would have gained by the inclusion of sample computation. To give an example of the author's brevity, he dismisses the question of the reduction of gravity results to sea-level in less than two pages, Bouguer, free air, isostatic and all, and does not quote a single actual measurement or discrepancy to prove his points.

Moreover, the American note predominates to the exclusion of much matter of interest; for example, although Prof. Hosmer writes at length on the figure of the Earth we hear nothing of Helmert's 1906 figure, or of those in use in France, India, South Africa, and Great Britain, and in writing on Isostasy the author does not even mention the work of the Survey of India.

The remainder of the book is devoted to a short and rather incomplete summary of map projections, and a more lengthy treatise on least-square adjustments. Both subjects are naturally too large to find proper treatment in a chapter, but the latter is dealt with as clearly and exhaustively as could be under the circumstances.

The book is well got up, printed on good paper, and well illustrated.

H. S. L. WINTERBOTHAM.

THE MONTHLY RECORD

THE SOCIETY

Mount Everest Expedition.

THE Joint Committee of the Society and the Alpine Club have now completed the appointments to the reconnaissance party of 1921, which is constituted thus : Chief of the Expedition : Col. Howard Bury ; Mountaineers : Mr. Harold Raeburn (leader), Dr. A. M. Kellas, Mr. G. L. Mallory, Mr. George Finch ; Medical Officer and Naturalist : Mr. A. F. R. Wollaston. The Surveyor-General of India telegraphs that, subject to the consent of the Government of India, the following officers of the Survey of India will accompany the expedition: Major H. T. Morshead, D.S.O., R.E., Captain Wheeler. The expedition will assemble at Darjeeling about May 10.

EUROPE

Symonson's Map of Kent, 1596.

The Society has been fortunate in securing a copy of the excessively rare map of Kent, bearing the title 'A New Description of Kent, Divided into the fyve Lathes thereof. . . . By the travayle of Phil. Symonson of Rochester, gent : 1596.' It is the first printed map of the county as such, with any fullness of detail, for the map covering this part of England in Saxton's Atlas of 1579 was a general map of the counties of Kent, Surrey, Sussex, and Middlesex. Including a narrow ornamental border, it measures 2 feet $6\frac{7}{8}$ inches by 1 foot $9\frac{3}{16}$ inches. and is on a scale of rather over half an inch to the mile, or about double that of Saxton's map, but almost the same as that of Norden's Surrey of 1594, of which, a year ago, the Society obtained the only copy brought to light in modern times. The engraver too, Charles Whitwell, is the same as that of Norden's map, only quite a few of whose productions are now known. Symonson's map was described with some care by the Hon. Henry Hannen, in a paper printed in the *Archæologia Cantiana* in 1913 and accompanied by a reduced facsimile, made from a copy which had come into his possession ; it was inserted, like the Society's, in a copy of Philipot's *Villare Cantianum*, of which the first edition appeared in 1659. Mr. Hannen was at some pains to trace the possible existence of other copies, but failed to hear of any on inquiry at several of the most important public libraries, even the British Museum being without the map. One other was, however, sold by auction at Sotheby's, inserted in a copy of Lambarde's 'Perambulation of Kent' (second edition, 1596) in October 1912, and a copy of the eastern sheet (of the two which compose it) is in the possession of Canon Livett, F.S.A., vicar of Wateringbury near Maidstone. The Society's copy thus appears to be only the third complete specimen known to students. The map bears evidence of careful compilation from first-hand knowledge, and is among the earliest to show the main roads. Its claims to be an improvement on former maps are fully set forth in the title, unfortunately too lengthy to reproduce in full.

This map is referred to in the second edition of Lambarde's book as "lately published" by his "good friend Philip Simonson of Rochester." This is important, the idea having been mooted that an erased date in the extreme corner of the map should read 1576, and that this was therefore the date of its first publication. The erased figures seem undoubtedly, however, to be 1596 in the Society's copy, in which they may possibly be more clearly legible than in the other known copies. As an argument in favour of the earlier

date, Mr. Hannen quoted a reference in the first edition (1576) of Lambarde to a then existing map of the county, with the name Medway applied to that river below Maidstone, whereas Saxton did not give the name at all. But an example which does give the name to the river, and below Maidstone only, exists in a map otherwise exactly copied from the Kent portion of Saxton, of which a specimen was secured by the Society last year inserted in the first edition of Lambarde ; this suggests that it may have been the map spoken of by the latter. Symonson's map was reissued several times, as described in Mr. Hannen's paper, the later issues being recognisable at once by the insertion of engraved views of Rye and Dover Castle, by Van Dyke and Hollar respectively. The map was finally reprinted (without Symonson's name) by Robert Sayer, the well-known map publisher, about 1770. Of the first issue a slight difference is noticeable between the known copies. In both Mr. Hannen's and the Society's the statement "Printed and Sould by P. Stent" occurs at the foot, engraved (Mr. Hannen thinks) by another hand than was responsible for the rest of the map. In Canon Livett's copy of the eastern sheet this does not appear. We are indebted to Mr. Hannen for several of the details given above, apart from his published paper in the *Archæologia Cantiana.*

ASIA

Remarkable Trough-faulting in Western Persia.

In a short paper illustrated by photographs and diagrams Prof. S. J. Shand describes in the *Quarterly Journal of the Geological Society*, vol. 75, Part 4, a remarkable valley due to trough-faulting at the south-eastern end of Asmari Mountain in the Bakhtiari country. Its interest lies in the fact that, in Prof. Shand's words, it is "so small that its whole extent can be surveyed from the top of one of its bounding walls, so free from soil and vegetation that each fault can be traced by the eye . . . and so perfectly preserved that the fault-scarps retain the grooves produced by the friction of the sliding rocks." Asmari mountain is a whale-back 16 miles long formed by a symmetrical anticline plunging at both ends. Near the more gradually sloping south-eastern end the fold has collapsed along its length, letting down the gypsum beds which once covered the limestone mass of the mountain into a trough bounded by scarps, one of which is 500 feet high. Downhill the trough is closed by a cross-fault nearly at right angles to the anticlinal axis. The stream which drains the trough crosses it at right angles after cutting a narrow gorge through the limestone; it has itself completed the formation of the trough by removing the softer gypsum beds by the help of tributaries developed along the main fault-lines. It might be supposed that the last downward movement took place at a very recent date ; but that this is not the case is proved by the distance to which the waterfall formed at the exit of the stream from the gorge has receded from the line of the fault. In the title to his paper Prof. Shand speaks of the valley as a "rift-valley," but some exception was taken to this by speakers after the reading of the paper, on the ground that the valley is not directly due to faulting, but to subsequent erosion. It is surely unwise to attach too definite a genetic significance to a term of this kind, seeing that, as in the case of the African rift-valleys, the mode of formation of the feature in question may long remain uncertain. It may also be noted that while the origination of the term "rift-valley" is generally attributed (as in the discussion above referred to) to Prof. Gregory, the fact seems to be that the latter merely adopted and popularized a term that had been used in East Africa before his first visit.

AFRICA

The Mackie Ethnological Expedition.

In the December 1920 number of *Man* Sir J. G. Frazer summarized the information obtained by the Rev. John Roscoe, leader of the above expedition, during four months' residence (February to June 1920) among the Banyoro of the western parts of the Uganda protectorate. Through the interest in his researches displayed by the native king he was able to gain a large amount of new and authentic information on the customs of the tribe, which are described at some length in Sir J. Frazer's communication. As is well known, the ruling class are all pastoral people (Bahuma) as in other countries of this part of Africa, and Mr. Roscoe was immensely struck with their skill in breeding cattle, which he thinks could be put to profitable use with British help. The agricultural people, known as Bairu, are treated by the pastoral class as slaves, and seem to belong to a very inferior race. Sheep and goats are kept by them as by their rulers, but rather for ceremonial purposes than for the sake of their flesh. On quitting Bunyoro the expedition passed to Soroti, a government stat on near the north-eastern arm of Lake Kioga, proceeding thence through the Teso country to Mbale on Mount Elgon (where Mr. Roscoe continued his former researches among the cannibal Bagesu), and thence 40 miles northward to Sebei. He had intended to go on into Karamojo to study the Turkana, but this intention was frustrated by the military operations then in progress. He therefore proposed to visit Busogo and then return to Bunyoro, starting thence on the homeward journey down the Nile.

AUSTRALASIA AND PACIFIC ISLANDS

Native Reserves in Central Australia.

In view of the threatened extinction of various interesting tribes of Central Australia, the Council of the Royal Anthropological Institute lately supported a movement initiated in Adelaide for the creation of reserves in the Northern Territory, Western Australia and South Australia, where these tribes might be protected from contact with deleterious elements in White and Asiatic civilization. The action taken has already borne fruit, a communication having been received from the Commonwealth Government (printed in *Man* for December 1920) announcing that an area has been set aside as an Aboriginal Reserve by the Governments of South and Western Australia. In a communication from the Office of the Agent-General for South Australia the area of the combined reserve is put down as about 42,000,000 acres (65,625 square miles).

POLAR REGIONS

The Northern Pole of Inaccessibility.

In a short article contributed to the *Geographical Review* for September 1920, Mr. Stefansson points out how incorrect it is to suppose that the degree of inaccessibility (or, more correctly, of difficulty of access) in the Arctic Regions depends mainly upon latitude, and he enforces his point by a map constructed to bring out what he calls the "Pole of relative Inaccessibility." Up to the present the usual method of attack of the unknown polar area has been to sail as far as possible in ships, and from the furthest point so attainable to travel with sledges drawn by men or dogs; the best journey yet made by this method being that of Peary from Cape Columbia to the Pole—a distance of 500 miles. Marking on his map the furthest reached by various explorers

round the border of the Polar area, he describes arcs of circles from these points with radii equal to 500 miles, thus marking off an area of inaccessibility at least equal to that of the Pole itself, which lies on its margin. North of Alaska, where no ship has pushed any distance from the coast, the area in question stretches south to below 80°, whilst the point within it regarded as the pole of inaccessibility is no less than 400 miles from the geographical pole. This result is of course merely theoretic, and Mr. Stefansson enumerates the several factors which may tend to modify it. These are: (1) currents, which are a serious handicap in the Spitsbergen region, but a help on the side of the New Siberia Islands or Wrangel Land; (2) the frequency of open leads, which seems to be a special obstacle north of Eastern Siberia and Alaska; (3) the trouble caused by pressure ridges, generally greatest near land, and where currents are violent; (4) the question of food supply, which becomes important only when the explorer adopts the principle so strongly advocated by Stefansson himself, of "living off the country." To such a one, the question of the distribution of animal life—restricted, from the explorer's point of view, almost entirely to seals—becomes of great importance. The seal is forced to keep breathing holes open in winter, and while stationary with reference to these is continually moving with reference to the sea-bottom; he may follow the movements of the ice right across the pole of inaccessibility. But there are "ice-deserts" where the ice is heaped up or remains stationary in an eddy, and there seals will be scarce or absent, so that the explorer who relies on local food-supply may be faced with a problem like that propounded by a rainless desert in the interior of a continent. Such ice-deserts are a serious danger, but this is lessened by the mere understanding of their existence.

Prof. Donald Macmillan's Expedition to Baffin Land.

Prof. Macmillan, a former coadjutor with Peary and leader of the recent American expedition to the Far North in search of Crocker Land, is planning a new expedition for the exploration of Baffin Land, the largest but little known island of the American Arctic Archipelago, and considered to be the third largest island in the world. The project has the support of Bowdoin College, in which both Peary and Macmillan received their education, and the work is expected to last four or five years. An 80-ton schooner with auxiliary power is being built for the purpose, and, according to present plans, will remain in the field during the whole duration of the expedition, being beached or otherwise protected during the winters, and used for cruising, dredging, sounding, and other work in the summer. Macmillan hopes to start next July. Baffin Land is also engaging the attention of Mr. Stefansson as a field for the breeding of caribou, for which the southern part of the great island will be chiefly in question.

GENERAL

University Library for Central Europe: Appeal for copies of the 'Geographical Journal.'

Under the presidency of Viscount Bryce, an organization known as the Anglo-American University Library for Central Europe has been formed for the purpose of helping the libraries of universities and other institutions in Central Europe to fill up the blanks in English and American literature caused in the first instance by the blockade, and more recently by the excessive cost of such literature due to the unfavourable rate of exchange. Its hon. secretary is Mr. B. M. Headicar, librarian of the London School of Economics. The

scheme aims at securing the resumption of exchange between scientific societies in this country and on the Continent between which such an arrangement was in force before the war, and also generally at supplying to continental institutions the literature of which they are so much in need. The transport of any such literature placed at its disposal will be arranged for by the Library. Among other periodicals, the *Geographical Journal* is much in demand, and it is thought that many of its readers might be willing to present their copies of back numbers for the purpose named, any issues from 1914 onwards being gratefully welcomed. The organization is entirely non-political and non-sectarian, and while the countries benefiting will be largely those who were enemies in the war, the scheme embraces also Poland and Čecho-Slovakia, to the universities of which large consignments have already been sent. Serbia is being provided with literature under a special scheme, but the transport question has hitherto presented insuperable difficulties in the case of Rumania.

New Developments at the American Geographical Society.

With the beginning of 1921 the American Geographical Society has made certain changes in its publications and general activities. The *Geographical Review*, which in 1916 took the place of the former *Bulletin* of the Society (see *Journal*, vol. 47, p. 315), will henceforth be a quarterly instead of a monthly publication, being issued in January, April, July, and October. Side by side with this a Research Series will be issued, of which fourteen numbers are already projected, and two will be ready at an early date. The first of these will be a monograph on Bering's voyages, containing the log of the famous voyage of 1741, with elucidations and suitable commentary by Prof. F. A. Golder, already well known as a student of the early Russian voyages to this part of the world. The Society will also publish a set of three maps of Africa, dealing with soils, vegetation, and land classification, compiled by Messrs. C. F. Marbut and H. L. Shantz. Another important line of research initiated by the Society is concerned with the geography of Spanish America, which has been placed in charge of Mr. Alan G. Ogilvie, as already mentioned in the *Journal*. It provides for the preparation of monographs and handbooks on special regions and topics, as well as the compilation and publication of maps on various scales, including sheets conforming to the plan of the International 1/M map. Finally, a school of surveying is being organized under the direction of Dr. A. Hamilton Rice.

Geographical Lectures at Johns Hopkins University.

A course of lectures on geography, to be known as the Gilman Memorial Lectures, has been inaugurated at the Johns Hopkins University, through the liberality of friends of its first president, Daniel Coit Gilman, who began his teaching career as Professor of Physical and Political Geography at Yale, and was a member of the U.S. Commission on the Venezuela–British Guiana Boundary in 1896–97. The first series of lectures is being given by Major Lawrence Martin, of the General Staff Corps, U.S. Army, well known to geographers before the war by his contributions to Glaciology and General geography. The subject is "Geographic Factors affecting Foreign Trade."

Eighth Italian Geographical Congress.

After an interval of ten years, due mainly to the war, a general meeting of Italian geographers will once more be held during the present spring, beginning March 29 and ending April 5. The meeting-place will be Florence.

Special attention will be given to various problems arising from the war to which geography may help to supply an answer, and also to the position of geography in the Italian school curriculum.

OBITUARY

Charles Edward Fagan, C.B.E., I.S.O.

By the death of Mr. C. E. Fagan on January 30, the Society has lost a Fellow of 32 years' standing, and an active member of its Council. He was about to retire from the secretaryship of the Natural History Museum, which he had served efficiently for 47 years. His loss will be lamented not only by his Colleagues in the Museum but by a wide circle of friends outside. Mr. Fagan came of a diplomatic ancestry, from which he inherited much of the diplomatic faculty. His grandfather, Robert Fagan, Consul-General in Sicily, was a man of remarkable character; his father, George Fagan, was British Minister at Caraccas, Venezuela; both of them married Italian wives, and naturally Mr. Fagan was much attached to Italy. He was the youngest of three brothers, and was born at Naples on Christmas Day 1855, his father being then a member of the British Legation in that city. Mr. Fagan came to England in 1864, and was placed under the care of Sir Anthony Panizzi, Director of the British Museum. He was educated at Leytonstone, and entered the British Museum in Bloomsbury as second-class clerk in 1873, at the age of 18. In 1882, when the Natural History Department was transferred to South Kensington, he went with it as a clerk in the office of the Director, Sir William Flower. He was promoted to a First-class Assistantship in 1887, and on the recommendation of the Director the Trustees promoted him to the vacant post of Assistant-Secretary in 1889. In 1919, on the appointment of Sir Sidney Harmer as Director, Mr. Fagan was made full Secretary, and had he lived he would have retired in March at the age of 65. During the thirty-two years that he acted as Secretary of the Museum, though not himself a scientific man, he mastered the requirements of every department of the institution from a scientific standpoint, realized the importance of affording facility for research, and of the duty of all concerned to render it attractive to the general public. His sympathetic nature, his tact, his diplomatic temperament, his business-like habits, and his sound judgment ensured the loyalty of the whole of the staff and the confidence of the Trustees and Director. He was singularly sweet-tempered, always kind, while his consideration for others was one of the marked characteristics of his nature. Mr. Fagan was naturally interested in geography, and, on behalf of the Museum, had dealings with most of the explorers of his time. His organizing power and business capacity were utilized in various directions outside the Museum. He acted as treasurer to the International Ornithological Congress in 1905, to the British Scientific Expedition to Mount Ruwenzori, and to the Society for the Promotion of Nature Reserves. It is admitted by those who can speak with authority that it is largely due to the administrative ability of this quiet, modest, lovable man that the Natural History Museum has attained the high position which it now holds among similar institutions throughout the world.

In 1876 Mr. Fagan married Miss Stronach, who died in 1905; he leaves one son, Dr. Horace Fagan. J. S. K.

Miss Susette M. Taylor.

We regret to record the death, early in 1920, of Miss Susette Taylor, who was among the first women elected Fellows of this Society in 1913. She had been educated abroad and at Lady Margaret Hall at Oxford, taking honours in Modern Languages (German and Italian) in 1886. Her linguistic ability was remarkable, and she improved her knowledge of European languages by extensive travel, as well as by special study in Spain, Russia, and Greece. Outside Europe she travelled in Canada, Australia, Fiji, Japan, North Africa, and Burma, and even penetrated to the borders of Tibet when on a visit to her sister, the well-known missionary traveller, in the Chumbi valley. During the war she did work in the office of the Censor of Foreign Correspondence, and later in the Geographical Section of the Naval Intelligence branch of the Admiralty, in both of which her linguistic talents were of much use. She was a good photographer, and the author of various literary and travel articles and translations.

CORRESPONDENCE

African Rift Valleys.

In reference to Dr. Ball's letter (vol. **56**, pp. 505–510) I have to remark as follows :

(1) The differences in the use of the word "scarp" are mere matter of definition. Some geologists restrict "scarp" to steep slopes due to faults in contra-distinction to "escarpments"—steep slopes due to denudation.

(2) Dr. Ball throws doubt on the existence of evidence for the origin of the Gulf of Suez as a rift valley in the Oligocene. That Gulf is the direct continuation of the Red Sea trough which, according to Dr. Ball ('S.E. Egypt,' 1912, p. 364), was formed in the Oligocene. For direct evidence regarding the age and origin of the Gulf of Suez, reference may be made to the latest publications of the Geological Survey of Egypt. Its two recent reports (Petrol. Research, Bull. Nos. 7 and 8, 1920) on the Zeit area on the south-western side of the Gulf of Suez reaffirm the prevalence and importance of a series of faults parallel to the Gulf of Suez, one of which is named the Shore Fault. According to these reports the faulting began in the Oligocene. The main western fault, says Bull. No. 7, p. 20, "is along the line of an older fracture formed before the deposition of the Miocene beds." "This portion of the Zeit peninsula," it repeats, p. 11, "had been subject to much pre-Miocene movement." The reports make it clear that the faulting was post-Eocene, and being pre-Miocene was therefore Oligocene.

That the faulting determined the Gulf of Suez is repeatedly asserted in these Bulletins. *E.g.* Bull. No. 7, p. 15, says, "The series then became the principal and most important line of faulting in the area by becoming the controlling factor in the formation of the shore-line of the Gulf." The beds along the eastern shore-line have an easterly dip, which, says the Bulletin, p. 16, is "the result of the faulting determining the present position of the Gulf of Suez." Bull. No. 8, p. 9, "This fault . . . is the determining factor of the shore-line." In the report of 1916 on the oilfields region, some faults shown on earlier maps were omitted, but after the more detailed recent survey the Bulletin No. 7, p. 19, now states that in comparing these results with those

in the 1916 Report, "it will be seen that the igneous upthrust is reaffirmed, but the effects of fracture following on folding are much more emphasized."

Dr. Ball refers to the sections in the Oilfields Report of 1916, pls. 2, 21, 22, 23. These sections are by Prof. Mrazec; and comparison of his section C, pl. 22 of the 1916 Report with that on Bull. 7, pl. 6, representing about the same line, by Messrs. Hume, Madgwick, Moon, and Sadek, shows the present opinion of the Geological Survey of Egypt as to the relative value of faults and folds in the formation of the Gulf of Suez. The sections strengthen Dr. Hume's former opinion in his criticism of Dr. Ball's theory of the formation of the Gulf of Suez by erosion, "I can conceive of no erosive agent which would break across this great earth-feature without the intervention of fractures" (*Geol. Mag.*, 1910, p. 386).

J. W. Gregory.

20 Dec. 1920.

In view of the great interest attaching to rift-valley problems, and especially in view of the importance of the tectonics of some rift valleys in connection with oil geology (in the case of Lake Albert, for example), may I venture to ask for a portion of your valuable space for publication of this letter?

When two years ago I came to this Protectorate as Government Geologist I found I had accepted Prof. Gregory's theory of the Great Rift Valley without question, but subsequently, after making a reconnaissance which included journeys both between Lakes Albert and Victoria and between the Mufumbiro Mountains in the south of the Protectorate and Nimule on the Sudan border, I found it necessary to alter my attitude and, at any rate, to suspend judgment.

In September 1919 I was asked to write a chapter on geology for a new edition of the Uganda Handbook: while realizing that any such attempt must perforce be premature, I was persuaded that a very general description would be better than nothing, and this I attempted. The Western Rift I described as due to the dropping in of long stretches of country along the axis of a compressional arch, but I did not commit myself to any statement regarding the manner in which this relative dropping had been produced. In my annual report for the year ended 31 March 1920, which owing to pressure of work in the Government Printer's Department and his want of staff and appliances is still unpublished, I said, "*According to Prof. Gregory the rift valleys are due to a relief of pressure, but doubtless Prof. Gregory would be the first to admit the case is at present not proven;*" then, after discussing some features of the Albertine portion of the Western Rift, I concluded, "*After all, very little is known of the Western Rift as far as this country is concerned; its features may be peculiar, and the extreme straightness of the fault lines must be a significant point. To my mind it is not yet certain whether the main factor in the production of the rifts was relief of pressure or the increase of it, but I strongly incline to the latter view.*"

As I am starting on safari in a very few days from now there is no time, at present, for the compilation of an adequate account of the facts that have led me to doubt the validity of Prof. Gregory's rift valley hypotheses as applied to the Albertine Rift: this, with your permission, I will attempt to give on my return. Meanwhile, may I state that in my view the geology of Uganda, as yet known, favours:

(*a*) The existence of a compressional arch in the Lake Albert region, but an absence of evidence pointing to a lack of support from below the arch consequent upon the outpouring of lavas.

(*b*) The existence of a zone of compression in the vicinity of the Uganda portion of the Western Rift.

(*c*) A differential longitudinal shift of the opposing scarps of Lake Albert.

(*d*) A differential transverse shift across the lake.

(*e*) A differential vertical shift of the opposing scarps.

(*f*) The association of volcanic outpourings with upthrusts rather than with downthrows in Uganda.

(*g*) The supposition that compression rather than tension is the main causative factor in the production of the Albertine rift valley.

(*h*) The direct tectonic origin of the rift topography as opposed to the indirect origin as supported by Dr. Ball.

I am, sir, yours faithfully,

E. J. WAYLAND,

Government Geologist.

Entebbe, Uganda, 9 December 1920.

MEETINGS: ROYAL GEOGRAPHICAL SOCIETY: SESSION 1920-1921

Sixth Evening Meeting, 24 January 1921.—The President in the Chair.

ELECTIONS.—Major Leonard Danels; Captain Valentine R. McMorrough Duigan, F.Z.S.; Lieut.-Gen. Sir Raleigh Egerton, K.C.B., K.C.I.E.; Sydney Fairbairn; Captain James Henry Green, I.A.; The Hon. Mrs. Piers Legh; Neal McNeill; Lieut.-Col. Seaburne Guthrie Moens, C.I.E., C.B.E.; Captain Brian G. Nixon, I.A.; Captain E. M. Persse, M.C.; Captain Gilbert Laurence Rogers, M.C.; Lieut. N. D. Semenoff-Tian-Shansky; Oswald Gordon Veall; Dr. Carlos Rospigliosi Vigil; Arthur Henry Webb; Captain K. W. Wilkins; Frederick Harold Woolliscroft, B.A., LL.B.

PAPER: The Lower Reaches of the Orange River. Mr. F. C. Cornell.

Seventh Evening Meeting, 7 February 1921.—The President in the Chair.

ELECTIONS.—Miss Lillie May Adam, B.A.; Mervyn Wolford Bidwell; Lieut. Patrick Stratton Campbell, R.N.; Herbert Reginald Culling Carr; Lieut.-Col. Edward George Cheke, R.A.; Charles Christian, M.B.E.; Major E. L. Croslegh, I.A.; Morley Thomas Dawe, F.L.S.; Aloys Hiff; H. Stuart Hotchkiss; Miss Frances Elizabeth Latham; William Lunn, A.M.I.E.E.; Ernest Channing Matthews; Frederick Albert Mitchell-Hedges; C. Michael Oppenheimer; Major Rupert Ernest Penny, R.A.F.; Major Albert Edward Perkins, K.A.R.; Mrs. Gertrude Jane Perks; Captain C. L. Reid; Sir Malcolm Seton, K.C.B.; Arthur Yuart Smith; Lieut. Gordon Charles Steele, V.C., R.N.; W. E. Stoakes; Ralph Stobart; Henry Gerard Thornton, B.A.; Miss Ada Winifred Wesley; Leonard Winfield.

PAPER: Mount Kenya. Dr. J. M. Arthur.

Fourth Afternoon Meeting, 14 February 1921.—The President in the Chair.

PAPER: Circulation in the Earth's Crust. Lieut.-Col. E. A. Tandy.

The Geographical Journal

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THE LOWER REACHES OF THE ORANGE RIVER

Fred. C. Cornell, O.B.E.

Read at the Meeting of the Society, 24 January 1921.

OF the many wild spots it has been my lot to visit during years of wandering in South Africa, none have appealed to my imagination to such an extent as the maze of pathless and intricate mountains through which the Orange River, after its giant plunge over the Great Falls of Aughrabies, winds its solitary and tortuous way to the sea. Nearly 300 miles it winds and zigzags, most of it through desolate and uninhabited country, much of it through deep-worn narrow gorges, between precipitous walls of rock, in many places unapproachable, and the last 150 miles practically unknown. This particular portion is known as the Richtersveld, where range after range of fantastic-shaped mountains have barred the river's passage to the sea, turning it back upon its course, and forcing it to describe a huge semicircle before it emerges from them into the more open but desolate country at Zendling's Drift, within 50 miles or so of the Atlantic. It is my good fortune to have taken several expeditions into these mountains, and to have at various times traversed practically the whole of the river-banks from the Great Falls of the Orange to the sea. These visits, several of them of many months' duration, have covered a period of some twelve years, my first trip having been in 1908, when the discovery of diamonds in the sands of Lüderitzbucht and in German territory immediately north of the Orange had led to some interest being taken in the region, and the latest having extended from January 1920 until a few months back.

For the purposes of this article, however, I shall treat the various expeditions as one, and endeavour to describe the river and the adjoining country from above the Great Falls to the sea.

At the time of my first visit the falls were very much more difficult of access than they are to-day, some 200 miles of desolate sandy country having to be traversed to reach them from Prieska, the terminus of the branch line coming from De Aar and the main line from Capetown to the north. But the war brought the linking up of the Cape Government railways with those of the recently conquered territory lately known as German South-West Africa, to-day a mandatory of the Union; and the new line

through Upington runs within a moderate distance of the falls. From Upington, where the river is spanned by a fine bridge, the usual route is along the north bank, downstream, passing through the verdant and productive lands of Keimoes, lands irrigated by gravitation furrows, and where oranges, grapes, deciduous fruits, vegetables, and cereals grow in astonishing profusion—for the silt brought down by the frequent floods of the Orange is equal in fertility to that of the Nile. These verdant stretches along the banks are the more remarkable from the fact that the outlying dunes of the southern Kalahari Desert run down to their very margin, and much of the "road" leads over these giant waves of soft red sand. Sixty miles of this road, and these smiling green river "lands," and Kakamas North Furrow is reached. Kakamas itself, the Labour colony founded by the Dutch Reformed Church, lies on the opposite (south) bank, and this article is all too short to make more than a passing reference to this remote and almost isolated community of some 3000 odd "poor whites." The settlement, which stretches for several miles along the banks, is communal; it is notable for the number of its churches, the fertility of its irrigated lands, and—strangely enough—for its poverty. At the time of my last visit, in 1914, the nearest doctor to this rapidly growing settlement was at Upington, fully two days distant—I say "days," for in this land of bad roads and sand-dunes it is time, and not mileage, that counts.

To return to the north bank, along which runs the route to the falls. Here, at a place called Krantz Kop, there is a well-stocked store, from which travellers usually make a start for Aughrabies; for this is not only the last store, but practically the last dwelling on the north bank before reaching the tiny police-post at Stolzenfels, many days' journey downstream and in what was till recently German territory.

From Krantz Kop the roads become every mile more atrocious, and after a few hours give place to the merest track. This leads away from the river, crossing granite and dolerite kopjes, and ridges where every step tempts a smash-up, and leading directly towards a formidable barrier of abrupt peaks. The surroundings become wilder at every step, and the strange shapes of the peculiar-looking vegetation, "Koker-boomen" (*Aloe dichotoma*), thorny candelabra euphorbiæ, and a variety of "melk-bosch" exactly like gigantic asparagus, lend a weird aspect to the landscape. The prevailing granite, pinkish and speckled with an abundance of rock garnet, is broken by a profusion of quartz reefs and outcrops, which as the late German border is approached gradually change from pure white through every shade of pink to the most beautiful of rose quartz, which in numerous instances becomes amethystine, and ranges from pale heliotrope to deep purple in colour. Many of these reefs are full of large crystals of jet-black tourmaline, beautifully faceted, and often as thick as one's wrist. Many of the giant boulders of granite are covered with lichens of extremely vivid colours, ranging from bright yellow to vivid scarlet, and across the

river runs a long range of peaks outlined like cockscomb, and noticeable even in this land of violent colour contrasts, for they are jet-black, as though made of coal. There is no sign of life or habitation, for with the exception of the small farmhouse at "Omdraai" (Turn back!) the whole country is uninhabited, except for a few nomad Bastards and Hottentots.

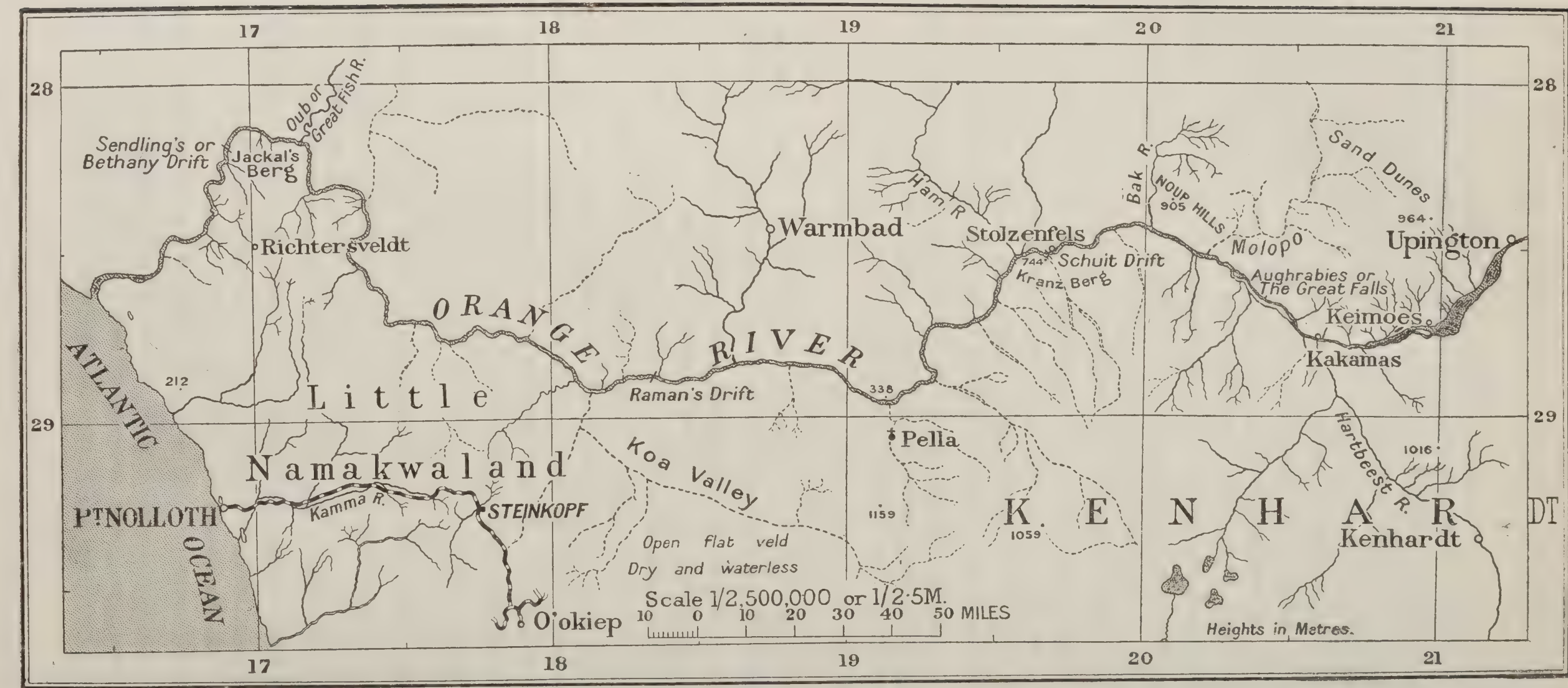
Passing this tiny lonely homestead, two hours on horseback brings one to Waterval, the name of the Government farm on which are the falls. There is no permanent dwelling here, but Oberholzer, a Dutch farmer, who knows more about the falls than any one living, can usually be found there, living in a canvas hut. To reach the falls a guide is absolutely necessary, for access to them is both difficult and dangerous, and indeed can only be obtained when the river is low.

Above the actual cataract the river, split up by numerous islands into various channels, is almost a mile in width, and to reach the main channel, where it takes its huge leap, several minor streams have to be first crossed. The first of these is dangerous, and the guide has to be followed very carefully. The water is always turbid and rapid, and one has to wade through it up to one's waist and grope for footing on a narrow ridge of rock, uneven and slippery, full of sharp points and pitfalls, and with deep water on either side of it. Downstream the rapids lead to one of the side falls.

Once across this stream an island of sand and silt is reached, split up into deep channels by past floods (it may be remarked *en passant* that at Upington the Orange often rises 30 or 40 feet in as many hours), and with plenty of big trees; then come more rapid streams, which, however, are easily negotiable over the huge granite boulders that encumber them. The last of these side streams runs in direction contrary to the others and to the general course of the river, and eventually disappears beneath the boulders, but can be heard rushing swiftly deep below.

Then comes an open boulder-strewn space, leading to a chaos of huge granite monoliths the size of houses, riven and shattered and piled upon each other in the wildest confusion, balanced and tottering, a maze of barren stone without a vestige of soil or vegetation. And emerging from a rift in this labyrinth of granite one stands suddenly on the edge of a profound chasm, over the farther lip of which, a few hundred yards upstream, the huge muddy volume of the Orange hurtles in one stupendous spout. The scene is terrifying, for the dark precipice, smooth as though chiselled, falls sheer away from one's feet, and where it does not actually overhang offers no foothold even for a baboon; the rocks are slippery and slimy with the constant spray, and the air and the solid rock itself trembles with the monstrous noise of the falls.

Rapidly converging from its great width upstream the main channel becomes pent in a deep bed, self-worn in the solid granite, until where it takes its final plunge it is concentrated into a terrific spout barely 20 yards in width, which hurls itself over the precipice a sheer 400 feet into the



Sketch-map of the Orange River from the Great Falls to the sea

CROSSING THE FIRST SIDE STREAM ABOVE THE GREAT FALLS

BOULDER-STREWN BED OF SIDE STREAM ABOVE THE GREAT FALLS

RAVINE ERODED IN GRANITE LEADING TO THE LOWER ORANGE RIVER


THE GORGE BELOW THE GREAT FALLS


GORGE IN THE RICHTERSVELD MOUNTAINS

gloomy abyss below. And with the plunge it practically disappears into the unknown, for many miles penned in a gloomy canyon, quite unapproachable and scarce to be glimpsed till it emerges into a slightly wider bed close to the border of what was recently German South-West Africa.

Higher than the Victoria Falls, and more than double the height of Niagara, the Great Falls of the Orange lack the spectacular beauty of either of its famous rivals. Impressive they are, but the impression they leave is rather one of terror than of pleasure, of awe rather than of beauty. On all sides there is nothing but riven, shattered rock, sheer precipice, and giant buttress: the vegetation of the side streams is hidden by the chaos of rocks near the brink of the canyon, and the scene is one of sheer desolation. This absence of vegetation and of life makes it additionally hard to realize the stupendous height of the main fall; the enormous smooth cliff opposite, the giant boulders, all confusing one's sense of proportion.

Discovered by the traveller George Thompson in 1824, they were named by him the Falls of King George, but are generally known as the Great Falls of the Orange; whilst to the writer's way of thinking their native name of Aughrabies is far more fitting than either of the others.

Some day, when civilization shall have spread so far, there will, of course, be safe bridges over the side channels, and mankind will be given an opportunity of seeing what no man yet can possibly have seen at close quarters and lived: the Orange River, in flood, filling not only its self-worn channel, but spreading all over the lip of that nightmare of an abyss in an appalling maëlstrom. Downstream from the falls it is impossible to follow the bank of the river, a native trail, cutting through terribly broken country away from the river, being the only means by which it can again be approached after it emerges from the gorge below the falls.

Thus far, in spite of the roughness of the track, that wonderful vehicle a Cape cart can be brought, but at Wag Brand, half a day's rough travelling below the falls, where the river is again reached, even this means of transport has to be abandoned. The track, which has been leading for ever downwards, is here penned in a narrow defile flanked by abrupt peaks. Further progress is barred by the swift river, and the only possible way downstream is around and along the almost precipitous flanks of the mountains, with no path, and with the swirling river immediately beneath. Usually there are a few Hottentots to be found at Wag Brand, and the traveller's belongings—if he cannot carry them himself—have to be carried by them if he wishes to proceed farther downstream.

For some distance the only path is treacherous, smooth, waterworn granite, sloping steeply into the rapid muddy current below; at times it widens into a belt of thick and tangled wood, full of grey monkeys and from which "pheasant" and guinea-fowl can be heard calling. Still one is penned in between the mountains, and eventually all way is barred by

a formidable peak rising sheer from the water. The way leads over the inland flank of this, and once over this ridge, the country, for a few miles at least, is no longer pent between formidable walls of rock. On the opposite bank there is a red mountain, flat-topped and striking looking even in this land of strange-looking mountains. It is known as Zee-coe-steek (Hippo's Kick!), and is the highest point in the Kenhardt district; but beyond this little is known of it, for the southern bank in its vicinity is almost as unknown and deserted as the wild and unsurveyed Noup Hills on the north bank, the "path" through which I am endeavouring to describe. Here, in the very broken but more open country mentioned, is the mouth of the Molopo, the ancient and long-dry river that at one time ran through what is now the Kalahari Desert, and whose course can still be traced for nearly 1000 miles to Ramathlabama Spruit, near Mafeking. Its junction with the Orange is choked with giant sand-dunes, through which usually but the tiniest trickle of water finds a way. Here, shut off by days of difficult trekking from any neighbours in any direction, there are a few Hottentots, refugees from German territory, who fled there at the time of the Hottentot war in 1903, and who have scarcely seen a white man a year since that time. When first I saw them they were in mortal fear lest we should prove Germans, and even after they learned that we were British and that they had nothing to fear from us, they were extremely reluctant to act as guides into the regions stretching westward through the wild Noup Hills to the German Border, with its possibilities of German patrols.

The comparatively open country at the junction of the Molopo with the Orange extends only for a mile or two, and northwards the Molopo bed can be seen narrowing into a deep and precipitous gorge. Continuing westward downstream along the Orange the mountains again converge and pen in the river. These mountains are split up into numerous deep narrow ravines, leading deviously and very gradually inland and upwards to the level of the flat country through which the Orange has through the ages worn so deep a bed. Most of the mountains are table-topped, and their flat summits are crowned with whole forests of the strange-looking Koker-boom, whilst the occcasional "spitz kop" (sugar-loaf mountain) which forms such a contrast to the table-topped variety, and which is equally characteristic of the region, is in reality only the result of more advanced stages of the same denudation.

In the lower levels near the present bed of the river this denudation has exposed much of the intrusive granites and dolerites, and the result has been the production of a country of the most rugged description, very difficult and dangerous to traverse. A day farther downstream and the ravine of the long-dead Bak River is reached, a deep ravine worn in the living granite, showing where once a mighty river joined the Orange from the now waterless desert stretches of the north. This river-bed, winding between steep mountain ranges, shows traces of extraordinary erosion for

hundreds of feet up the granite slopes, the actual bed being so smoothly carved and polished in the hard rock as to make it difficult to traverse even on foot.

This ravine is almost exactly on the 20th degree of east longitude, and as its course runs roughly north and south, some of the international beacons (which extend for hundreds of miles at irregular intervals due north through the desert to the Caprivi belt) stand in the centre of the actual river-bed, and the western bank of the dry river is generally considered the beginning of German South-West Africa. Before the war a German police patrol from Stolzenfels occasionally visited the Bak River, but very rarely and with difficulty, as the mountains are extremely difficult to traverse even on foot, and the region is thirst-ridden and quite uninhabited. Leopards abound in the ravines, and the native guides—when they can be obtained at all—fear them greatly.

Downstream, and now in what was till recently German territory, the mountains rise higher and higher—or rather the Orange and its dead tributaries have eaten deeper into them. To follow the actual bed becomes impossible, the slopes being almost precipitous, and the only way being over the high flat-topped mountains. These are traversed in all directions by deeply eroded gorges, which entail long détours to negotiate, and although the Orange may be in full view most of the time one is crossing these difficult hills, it is so hard of access that the unwary traveller may well die of thirst in full view of it. Here and there the peaks recede somewhat from the bed of the river, and then the narrow stretches of silt are clothed with dense vegetation. The mountains once crossed, a lonely habitation is again reached, at a little police post at Stolzenfels. More mountains, interspersed now with wider stretches of open country covered with "toa" (Bushman grass), and the river becomes more approachable. At Scuits Drift, as the name implies, there is a drift or ford where roads cross from British to German territory from what is generally known as "Little Bushmanland."

Lower down, and passing through similar rugged and very sparsely inhabited country, there stands near the British bank the little mission station of Pella, where the Catholic fathers have done splendid work with the wretchedly poor Hottentots of the vicinity. Fine gardens, beautiful vineyards, luxuriant vegetation, show what can be done with the wonderful silt of the Orange and its lateral valleys, whilst in the mission itself the natives are taught a variety of useful trades. The vicinity of the settlement is extremely rich in minerals; indications of copper are to be seen on all sides, and many mineral leases have been taken out in the vicinity, but the great distance from the railway has so far prevented any attempt at working them.

Raman's Drift, the next inhabited spot downstream, was prior to the war a police post of great importance, for through it leads the main transport road from the Cape Copper Company's little railway at Stein-

kopf, Namakwaland, to Warmbad, an important town some days' trek inland in the old German territory. During the Hottentot rebellion in the latter country in 1902–3 this road was greatly used, much of the German supplies being landed at Port Nolloth, Namakwaland, brought up to Steinkopf by the private railway already referred to, and thence transported by tedious ox-waggon—or even more tedious donkeys—through the Drift to the German base. In the latter part of 1914, and in 1915 during the invasion by the Union troops of German Territory, this route was again the scene of extremely busy transport, and we had an important supply base there; but with the linking up of the main South African Railway system with that of the late German system from Prieska through Upington, Nakob, and Kalkfontein, the old waggon route has ceased to be of any importance, and is practically deserted.

Just below Raman's Drift is Goodhouse, a farm which is a shining example again of what energy and capital can do with Orange river silt, combined with irrigation and the wonderful sunshine of Namaqualand. For here are grown fabulous crops of oranges, lemons, grapes, and other fruits, whilst lucerne (much used as fodder all over South Africa) yields no less than eight or nine crops per annum. The fertility of this and similar spots is altogether astounding, and when the proposed railways come within a reasonable distance of the region it cannot fail to become one of great prosperity.

With this beautifully cultivated farm, civilization, or even habitation along or near the river comes to an end, the lower reaches for fully 150 miles being uninhabited except by a few wandering Hottentots. For here the vast granite ranges of Namakwaland that run almost north and south, and form as it were the backbone of the country and of the adjacent territory to the north, turn back the Orange on its way westward to the sea, throwing it north, and in places even eastward, in the big semicircle referred to in the opening part of this article, the wilder parts of which are known as Richtersveldt.

Journeying along the banks of the river is here in many places even more difficult than in the Noup Hills already described. The mountains, where not of granite, are of quartzite and conglomerate interbedded and tilted at an awkward angle, or of schist so metamorphosed as to crumble to the touch—the latter affording most treacherous hand or foothold over the slopes and precipices which have to be crossed to penetrate the country. There are no roads whatever, a few bridle paths, or game paths known only to the natives, being the only routes. The region is again almost waterless; the river is in parts unapproachable for distances which, although trivial on the map, take several days of hard climbing and scrambling to traverse, and an accident, however trivial, may mean death from thirst. Indeed, thirst, and the anxiety as to where and when water will again be found, is ever present, and overshadows all other considerations.

Whenever possible I have followed the actual river-banks around this semicircle, in places, where the peaks recede from the water, having to hew a path through a tangle of virgin forest and undergrowth. The actual margin of the river is usually overhung with a beautiful, vividly green species of weeping willow, the huge trunks of which have rotted and fallen over each other through the ages that they have remained undisturbed; there are also several varieties of thorny acacias; high, graceful "cameel doorns" 40 or 50 feet in height, covered with little yellow blossoms that scent the air with the perfume of English cowslips; big black-barked trees known as "zwaart beis," beautifully foliaged "haak-doorn," bastard ebony, and a host of other trees and bushes. Here and there there are stretches of bright green turf, bird and animal life is plentiful, and altogether these pleasant stretches are very beautiful—the more so by contrast to the barren wilderness of scorched rock stretching for many days' journey on either hand. The river itself, where the mountains allow of it, is generally from 100 to 300 yards in width; there are many long stretches of 4 or 5 miles quite of the latter dimensions, and they are in some parts of great depth. Some of the holes, plumbed with a fishing-line by myself, have shown 70 or 80 feet of water at the river's normal height; and the long stretch opposite my last camp at Zendling's Drift, which I was able to sound systematically from a boat made on the spot, showed for miles an average depth of 25 feet on a width of about 300 yards. Occasionally these calm, solitary, and silent stretches are broken by noisy rapids, some with sufficient volume and current to provide enormous turbine power—if the country is ever opened up. At the apex of the semicircle, and at one of its wildest and most difficult parts, the Great Fish River, which almost bisects the late German Territory from north to south, joins the Orange. Usually almost dry, this once big river, which in the past has had a volume as great as that of the Orange, and whose bed lies in a similar series of deep ravines, is even to-day subject to periodical floods, and at times a huge volume of flood water pours down it into the Orange. At its confluence with the latter the wide mouth, like that of the Molopo, is greatly choked with sand, and the small densely wooded islands in the vicinity are the favourite haunt of the few hippo still to be found in these rivers.

Below the Great Fish, a two days' arduous journey brings one clear of the mountains at a triangular-shaped piece of open country opposite Zendling's Drift. But this journey is of great hazard; in places the only route lies for miles along the steep slope of the mountains, along the lower part of which soft sand has piled itself up at a very steep angle. This slips down bodily towards the swirling water as one walks, and constant movement is necessary to save one from being swept into the water in a miniature avalanche of sand. In other parts huge dolerite dykes bisect the river, and their highly polished flanks are so slippery that they are barely negotiable with rubber-soled boots, or by the naked feet of the natives.

At Zwaart Poort, near Zendling's Drift, the river at length begins to emerge into more open country, as the mountains recede from it for several miles. In this vicinity, comparatively recent (geologically speaking) volcanic action is very noticeable; several of the mountains are cup-shaped craters, though long since extinct, and the foothills near them are a horrible desolation of black lava, pumice, basalt, and scoriæ, in which nothing grows. Under these hills, and between them and the river, are some extraordinary gravel terraces of huge extent, in places from 200 to 300 feet in height, and consisting of innumerable layers of gravel. The surface of these terraces is an extraordinary sight, for most of the pebbles are agates, jaspers, chalcedonies, sards, and other semi-precious stones usually associated with the diamond, and all so sand-polished, so oxidized by the impregnation of iron, which abounds in the vicinity, that the whole appears like a polished mosaic.

A road here at length penetrates the mountains from the outer world: this leads from Port Nolloth to Zendling's Drift, where on the north bank the Germans had a fine police post, long since abandoned. This drift, no longer used—and in fact no longer in existence, for the river has changed its bed since then—was at one time a recognized route between northern Klein Namakwaland and Damaraland; and here Sir James Edward Alexander, one of the first Englishmen to visit and describe the country, crossed into Damaraland in 1837. His book, published in 1838, and entitled 'Expedition of Discovery into the Interior of Africa,' describes the route in question, and gives a good deal of quaint and accurate information of a good deal of the region. The rare traveller of to-day who wishes to reach Zendling's Drift has to trek laboriously by ox-waggon from Port Nolloth, some 80 or 90 miles distant only, but so difficult is the road, so heavy the sand of the coastal belt, and so precarious the water-holes *en route*, that the journey usually takes five days or more; and my monthly store waggon during my last trip there, when I stayed from January to June at the drift, scarcely ever did the journey under seven days.

Except for a few prospectors, no one ever goes into the country. Prospectors are lured there by the wonderful mineral wealth that abounds on every hand, but which difficulty of transport has so far kept from being exploited.

The few natives are nominally Hottentots, though many of them are of very diverse mixed breeds. For some sixty or seventy years ago this region formed a sort of native Alsatia, to which refugees from all sorts of tribes fled for refuge, and they, intermarrying with the native Hottentots, have left a strange hybrid race behind them. Still, the majority are Hottentots, and all speak the click language of that race. They are nominally members of the Rhenish Mission at Steinkopf, many days' journey away, and they had a tiny stone-built chapel in the mountains of Richtersveldt, about two days' journey from the drift. But the native

missionary died some years ago, and his place has never been filled. They are wretchedly poor, and lazy and thriftless to a degree, living (or rather half starving) on the milk of their goats, and making no effort whatever to till the soil or to try to do anything with the natural possibilities surrounding them. They are very primitive, and, though living mostly by the river, have never made a boat or canoe. Instead, they cross the river by a curious swimming-log, made from a long log of dry willow, into which a peg is driven to give them a grip. Astride this, and paddling with one hand, men, women, and quite small children cross the wide river even in flood-time. These floods, to which I have already alluded, at times swell the river to an enormous extent, and in February last it rose nearly 100 feet just below where it emerged from the mountains, and for days submerged even the highest trees. Near the drift itself it was for several days nearly half a mile in width, the swirling flood of muddy water carrying along in its centre an endless line of big dead trees; and the pity of it is, that in a land where water is a precious commodity, this huge flood benefits no one. Just below the drift a long hog-backed mountain known as Jackals Berg abuts upon the river, and makes travelling along it again dangerous. This mountain is remarkable for a huge deposit of iron ore, hæmatite of very high grade forming a big spur of it, and a fine reef of it running for many miles towards the sea.

A day's trek brings one to open country, the last 30 miles or so of the river running between undulating bush-clad country, most of it granite débris from the mountains I have described. Within a few miles of the sea one comes at length again upon a tiny habitation; for here, at a place called Groot Derm, there is a little homestead belonging to a farmer named Louw, a sheep and horse breeder, who at one time bred horses extensively for the Germans. There was also a tiny German police-post on the north bank, but this again is deserted, and his nearest neighbours to-day are many days' trek in any direction.

The actual mouth of the river itself is a series of sand-flats and sluggish channels, miles in width, covered with a multitude of flamingo and other wildfowl, closed by a bar of sand against which the big Atlantic breakers thunder incessantly. There is no post or settlement here of any kind, and the whole coast-line to Port Nolloth, two days' long journey south, is as lonely and deserted as when Bartholomew Dias landed here—at Cape Voltas, about 5 miles from the mouth of the Orange—in 1487.

The development of the region can take place only when the linking up of the Cape Government Railway through Namakwaland with the Cape Copper Company's private line at Ookiep shall have been accomplished. At present the railhead in that direction is at Klaver, a good 200 miles from Ookiep, but the project has long been mooted and much of the route surveyed. The natural extension to this route would be from Steinkopf, Namakwaland, to Warmbad, in the new Protectorate, over the old transport route already referred to, and crossing the Orange at

Raman's Drift. This would tap much of the country east of the Richtersveldt mountains, and here there is promise of great development in irrigated lands, similar to those at Goodhouse, whose wonderful crops have already been touched upon. Oranges and deciduous fruits thrive and yield abundant profit, even to-day, when transport is most difficult and costly. Except for the precarious rainfall the adjacent country is exceptionally good for stock raising, and with the advent of a railway great developments may be expected in this direction.

Westward, in the Richtersveldt region, the problem of transport is more difficult, and the proposed line would do little to open up this country. Its many mineral deposits, however, and the fact of the abundant water of the Orange traversing it, are bound eventually to lead to the making of roads from the present Cape Copper Company's railway, some 15 miles from Port Nolloth, to the river at Zendling's Drift, and a particularly valuable discovery of minerals might lead to a railway following the same route. Irrigation schemes along the river would be bound to follow, and these would be an end to the anomaly of this fine body of water running to waste in a land where water is the most precious of commodities.

Before the paper the PRESIDENT, after recounting the progress of arrangements for the Mount Everest Expedition, said: The lecturer to-night is Mr. Cornell, who has spent more than twenty years of his life exploring in South Africa and along the course of the Orange River; this evening he will give us an account of his experiences in an almost unknown country.

Mr. F. C. Cornell then read the paper printed above.

After the paper the PRESIDENT said: I am afraid I took up too much time at the beginning of the evening, so that there is not time now for a discussion, but I think you would like to express to the lecturer our very warm thanks for the attractive manner in which he has given us an account of the wonderful country through which he has passed. I shall recommend him to the Alpine Club for Mount Everest! I am sure if we tell him there are diamonds on the top of Mount Everest he will find his way up. I do not think these diamond-seekers mind particularly if they find the diamonds or not. What they like is the adventure and seeing wonderful countries, and the fine free life they lead. It is fortunate that the lecturer did bring home his photographs, because unless he had brought them we might have thought he was indulging in "Travellers' Tales." I have been in some pretty odd parts of the world myself—in the Gobi Desert, the Zungarian Desert, and in that part of the Himalaya, the Karakoram Pass, which travellers describe as the "valley of the shadow of death," but I must say that in all my travels I have never come across so grotesque and chaotic a country as we have seen this evening. It gives us an idea of what this Earth must have been like in those far-away days before vegetation had appeared in any part of the world. Our adventurous lecturer can give us an idea of what the Earth in its primitive condition was like.

KOKER BOOM—*ALOE DICHOTOMA*—ON THE PLATEAU ABOVE THE RIVER

SMOOTH GRANITE BED OF THE DRY BAK RIVER

ZENDLING'S DRIFT AND MITRE MOUNTAIN

STEEP BANK OF THE LOWER ORANGE OPPOSITE MITRE MOUNTAIN

MUD CRACKING ON SUBSIDENCE OF FLOOD: LOWER ORANGE RIVER: MITRE MOUNTAIN IN DISTANCE

THE HISTORY OF THE CHRONOMETER

Lieut.-Commander Rupert T. Gould, R.N.

Read at the Afternoon Meeting of the Society, 13 *December* 1920.

THE history of the marine chronometer, from its early beginnings to its present form, covers a period of about two hundred years, and I cannot hope, in the time at my disposal, to give you more than a rough sketch of the steps by which it was developed, and of the lives and work of the small body of men who were responsible for that development.

The chronometer came into existence as a particular solution—and, up to the present, the best solution—of the problem of finding longitude at sea. This problem is at least as old as the fifteenth century, when navigators began to make long sea voyages and consequently to get out of sight of land. They soon discovered that to find their latitude was a comparatively simple affair, but that their longitude was a matter of guesswork, and it was over two hundred and fifty years before a general method of finding it, by any other means than "dead reckoning," was discovered. Several theoretically correct methods were proposed, but the practical difficulties in the way of executing them proved, for a long while, insuperable.

The method of combining astronomical observations with a standard of time carried by the observer is, of course, that employed to-day. The local time of the ship's position is found by observation, and the Greenwich time obtained from the chronometer, allowance being made for its rate of gain or loss. The difference gives the ship's longitude.

Although proposed by Gemma Frisius in 1530, this method remained dormant for some two hundred and fifty years, since no machine could be made to keep sufficiently accurate time at sea. As a matter of fact, the accuracy required, which excludes errors of more than a few seconds in twenty-four hours, was not reached, even in astronomical clocks on shore, for nearly two centuries. Consequently sailors continued to depend for their longitude upon "dead reckoning," which simply means keeping as accurate an account as possible of the ship's courses steered and distances logged, and so calculating her change of longitude from her last observed position. This method, at the best of times, was subject to errors of all kinds—unknown compass errors, errors in logging, clerical errors, currents, allowance for leeway, etc., and it is not surprising that ships were often hopelessly out in their longitudes, and that in consequence shipwrecks were frequent. Two good examples of the defect of longitude by dead reckoning are to be found in the narrative of Anson's famous voyage. In 1741 he spent over a month endeavouring to round Cape Horn to the westward, and having, by his reckoning, made good enough westing to place him 10° clear of the most western point of Tierra del Fuego, stood to the north, only to sight land right ahead and to find that owing to an unsuspected

easterly set he was still on the eastern side of the cape. Again, after rounding the Horn and parting company with his squadron, scurvy broke out aboard the *Centurion*, and Anson, with his men dying like flies, ran to the northward, hoping to make the island of Juan Fernandez, to re-fit. In the ordinary way the method for making such islands was to get into their latitude and run along it, a plan still practised by many Pacific traders. To save time and lives, and in view of the fact that a few more days of her present death-rate would leave the ship too shorthanded to go about, he sailed straight northward for the island, with the result that he reached its latitude without sighting it, and was uncertain whether it lay to the eastward or the westward of him. He ran westward until (unknown to him) he was within a few hours' sail of the island; then, concluding he was wrong, stood eastward until he made the coast of Chile, and then ran back westward over the same ground until he made the island. This uncertainty as to his longitude lost him the lives of a number of his crew, who would probably have recovered if they could have been got ashore. This is no isolated case.

Many rewards had been on offer for a long time for the discovery of some better method of determining longitude: thus in 1598 Philip II. of Spain, possibly stimulated by memories of the Armada, offered a hundred thousand crowns, and the Dutch Government, soon afterwards, thirty thousand. The Spanish Government, also, for many years paid out small sums to encourage inventors, and cranks of all kinds, competing for their big reward; thus we find Lorenzo Ferrer Maldonado, the reputed discoverer of the Strait of Anian, receiving 200 ducats in 1626 for his discovery of "a compass without variation," which was expected to be of great use in finding the longitude (but why, is not obvious).

But the largest and most famous reward was that offered by the British Government in 1713, and it has the additional distinction of being, I believe, the only one which was ever paid. The main cause of its offer was not, curiously enough, the pressing needs of seamen, but a chimerical scheme brought forward by two gentlemen named Whiston and Ditton, whose names are now only remembered as the subject of a coarse poem by Swift.

They proposed that permanent floating lightships should be established at fixed points on the principal trade routes, firing at intervals star-shell arranged to burst at a height of 6440 feet, thus affording ships an opportunity of determining their distance from the nearest lightship by timing the interval between the flash and the report. They added that this method would be of particular use in the North Atlantic, where, they calmly stated, no depth exceeded 300 fathoms.

Whiston and Ditton, backed by a strong petition from the merchant shipping interest, procured the appointment of a committee to examine both their project and the whole question of finding longitude at sea. The outstanding feature of this committee was the evidence given by Sir

Isaac Newton, one of its members, who gave a short sketch of the "several projects, true in theory, but difficult to execute," proposed up to that time. It is noteworthy that he puts the chronometer method first.

As the result of the committee's report, a bill was passed offering the following rewards: £10,000 to the inventor of any method which, in the course of a voyage from England to any of the West India Islands and back, could determine the vessel's longitude to within 1°; £15,000 if it determined it to within 45′; and £20,000 if it determined it within half a degree.

At the same time the committee was remodelled as a permanent official body, having the title of the "Royal Commissioners constituting the Board of Longitude." This Board remained in existence for over a century, being finally dissolved in 1828. During its lifetime it had disbursed public money to the extent of £101,000. And here it may be mentioned that the Board of Longitude, like their Spanish predecessors already quoted, found themselves much exposed to the numerous tribe of cranks who are always to the fore when such questions are under discussion. By some obscure process of reasoning it became a widely received notion that the solution of the problem of longitude was inseparably connected with the perpetual motion and the squaring of the circle. And since there has hardly ever been a time when many people have not firmly believed that they possessed the solution of one or both of these problems, it may be imagined that their communications, together with a large number from lunatics and impostors, rendered the work of the Secretary to the Board somewhat harassing. To this day there are people who firmly believe that the British Government has offered an enormous reward for an exact value of π, and this error is entirely due to the £20,000 prize it once really did offer for "the discovery of the longitude."

The reward remained on offer for fifty years, and was then won by a chronometer, which thus asserted, for the first time, its definite superiority over all other methods of finding longitude at sea. Such machines had been tried before, but all had been failures.

The first attempt at constructing a marine timekeeper was made by the celebrated Christian Huyghens. About 1662 he constructed two clocks driven by springs, and fitted with short pendulums beating half-seconds. They were tried at sea by a Scottish officer named Major Holmes with moderate success, but it became evident that as a controller the pendulum was unsuitable for use at sea. Huyghens subsequently re-designed his clocks to be controlled by a balance, but although he worked on them for a long time he was unable to get satisfactory results, and concealed his failure in a cryptogram. At the same time Leibnitz, the great German mathematician, published an account of a marine timekeeper which he had invented. From his description it is obvious that it could never have worked, and it only affords confirmation of the fact that

Leibnitz, once he got outside the subject of pure mathematics, was prone to write on sciences whose principles he had not thoroughly mastered.

The next attempt was made by Henry Sully, an Englishman who spent his life in France and devoted it to horology. Sully was born about 1685, and died, prematurely and very poor, in 1728. He produced a watch, for use at sea, with two balances geared together, and in 1724 he presented to the Academy of Sciences a machine by which he believed he had solved the problem. Its controlling mechanism was a weighted lever, pivoted on friction rollers, and connected with a balance by means of a fine wire or silk thread playing between cycloidal cheeks. This design is, I believe, unique.

Sully made a number of these machines, which, when tested on shore, went fairly well at first, but soon became inaccurate. He abandoned this design, but while working on a new one died of inflammation of the lungs, brought on by overwork. One of his curious machines is preserved in the Museum of the Clockmakers' Company at the Guildhall, amongst a magnificent collection of old chronometers and pocket-chronometers, which any one who is interested in the subject should not fail to visit.

After Sully came the "father of the chronometer," John Harrison, winner of the £20,000 reward, and producer of the first reliable marine timekeeper. Harrison was a Yorkshireman, born at Foulby in 1693. He was brought up as a carpenter, but soon acquired a passion for clockmaking. At the age of twenty-five he had invented two very considerable improvements in the pendulum clocks of his day. One was the "gridiron" pendulum, in which the effects of heat and cold in lengthening or shortening it, and consequently making it swing slower or faster, are neutralized by a combination of brass and steel rods, which have, of course, different ratios of expansion. The other was a peculiar and delicate escapement called, from its appearance, the "grasshopper" escapement, which needed no oiling and had hardly any friction.

Harrison next turned his attention to winning the great reward, and designed a marine timekeeper. In 1728 he journeyed to London with his drawings, his pendulum, and his escapement, hoping to get assistance from the Board of Longitude. It is very doubtful whether he would have done so, but Fortune directed him instead to George Graham, a famous London clockmaker. Graham very wisely advised Harrison to make his machine before approaching the Board. He also helped him by lending him money, for which he refused to accept either interest or security.

From 1728 to 1735 Harrison was occupied in building his first timekeeper. Through the great kindness of the Astronomer Royal, I have the honour of being able to exhibit this identical machine to you this afternoon. It has been recently cleaned, but is not in going order. As you see, it has two enormous balances, which were connected together by wires in a practically frictionless manner. The balance springs, which are

missing, were four in number—helical springs in tension, acting on the ends of the balance-arms. Harrison made a clever use of his gridiron compensation to neutralize the effects of heat and cold on them. The escapement was a "grasshopper" in two parts, half being fitted on each balance staff, and both acting on the same escape wheel. Finally, he provided the machine with a small spring to keep it going while the mainspring was being wound up (which was done by pulling a cord coiled on a drum).

Crude though it may be, it is hard to praise this machine too highly. In my opinion, it is one of the most wonderful pieces of mechanism ever made. In constructing it Harrison, working single-handed and self-taught, grappled successfully with problems which had defied all previous efforts at solution. If the word means anything, he was a mechanical genius, and certainly he had "an infinite capacity for taking pains." For instance, all the wheels, except the escape-wheel, are of wood, turned out of solid oak, with the teeth, also of oak, let in in groups of four. These teeth, in turn, engage with pinions fitted with lignum-vitæ rollers to avoid friction. It is curious that Harrison, although he gave up the use of wood in his later machines, returned to it eventually. After his death an unfinished chronometer was found among his effects, made of several different alloys, such as bell metal and tutenag, while the arms of the balance were formed of hard wood.

Harrison completed the machine in 1735, and tried it successfully in a barge on the Humber, having made for it a wooden box slung in gimbals. He then applied to the Board of Longitude for a trial at sea, and was sent with it to Lisbon in H.M.S. *Centurion*, the ship which, some years later, took the Acapulco galleon and brought Anson home with nearly half a million sterling. Harrison and his timekeeper returned in H.M.S. *Orford* a month later. I have examined the logs of these two ships, but they do not say much about him. The machine, however, undoubtedly performed very well, and the captain of the *Orford* gave Harrison a certificate in which he stated, "When we made the land, the said land, according to my reckoning (and others) ought to have been the Start; but before we knew what land it was, John Harrison declared to me and the rest of the ship's company that, according to his observations with his machine, it ought to be the Lizard—the which, indeed, it was found to be, his observations showing the ship to be more west than my reckoning, above one degree and twenty-six miles."

Harrison exhibited his machine to the Board of Longitude soon after his return, and they advanced him £500 and desired him to make another, if possible a smaller one. As a matter of fact, he made three others, but none was tried at sea until 1761, and in the mean time he had a hard struggle to live, although the Board gave him several sums of £500 at intervals to assist him. These were subsequently deducted from the reward he received.

In 1749 the Royal Society awarded him the Copley medal, and long afterwards they offered to make him a Fellow, but he declined the honour in favour of his son, William Harrison, who had grown up to be his father's right-hand man.

Harrison's second and third machines may be passed over, since they exhibit only detailed improvements over No. 1, but in his No. 4 machine, which was a large watch about five inches in diameter, he produced a most wonderful piece of mechanism.

He abandoned in it the huge balances and complicated anti-friction devices of his earlier efforts. No. 4 is, in many ways, an enlarged version of the common pocket-watches of Harrison's day, with the addition of a number of contrivances which removed practically all the causes of their defective time-keeping.

First of all, he contrived a secondary spring to keep the watch going while the mainspring was being wound—a device which, as we have seen, he had fitted to his first machine many years earlier. There is no question that this "maintaining spring" was Harrison's invention, and it is still fitted in chronometers. This is the only one of Harrison's inventions which has not yet been superseded.

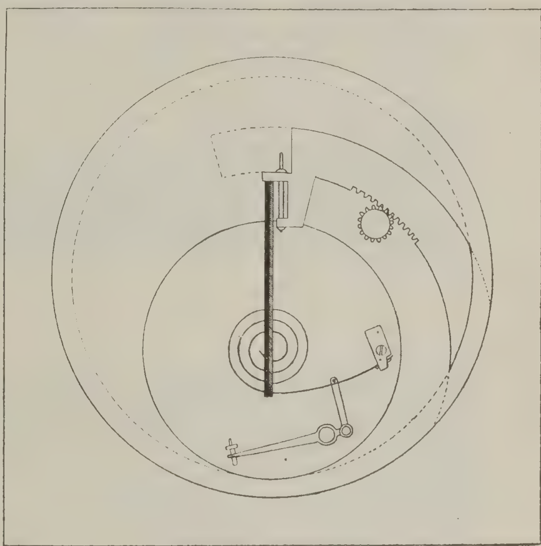
Secondly, he eliminated the errors caused by friction in the train of wheels by fitting a small spring which drove the escape-wheel direct, and which was wound up eight times a minute by the mainspring, the latter, of course, being wound once a day by hand. In this way he arranged that the force driving the escape wheel was practically constant, since the small spring had ten turns and never uncoiled more than a sixth of a turn before being rewound. This device, which is known to clockmakers by the name of a "remontoire," had been used by both Huyghens and Sully, but Harrison's application of it was novel and effective, and although the "remontoire" is no longer used in any form in chronometers, the detached escapement having rendered it superfluous, it was a powerful factor in Harrison's success.

It is worthy of note that the modern Riefler clock, the most accurate timekeeper yet made, employs this principle, and is wound every forty seconds.

Thirdly, although Harrison, not having room to fit his "grasshopper" escapement, retained the clumsy one of the watches of his day, called the "verge" escapement, he had shorn it of most of its errors by his remontoire, and he proceeded to improve it still further by making the pallets—the parts of the balance acted on by the escape wheel—of diamond, and curving them so that they were less effective when the balance vibrated through a long arc than when it described a short one. For the same purpose, that of isochronizing the arcs, he added a small pin, which he named the "cycloid pin," which was touched by the balance spring when the balance vibrated a long arc, and so, by reducing the spring's effective length, increased its strength. As a matter of fact he rather over-corrected

the defects of his escapement, and his balance described long arcs in slightly less time than it did short ones.

Finally, he provided his watch with a compensation for the effects of heat and cold. A rise of temperature makes a balance spring weaker, and also increases the moment of inertia of the balance, so that its beats are slower, and the watch loses. Cold has the reverse effect. When an ordinary watch is regulated by moving its indicator to "fast" or "slow," what happens is that one alters the position of two little pins, which hold the outside coil of the balance spring between them. By so doing you alter the effective length of the spring, and thus make it stronger or weaker. Harrison arranged an automatic way of doing this, and he used the same difference between the ratios of expansion of brass and steel which, as we have already seen, he employed in his earlier machines. Here is a view of his mechanism for effecting it. He took two thin strips of brass and steel and riveted them together, so that they formed a single compound strip, and he provided that two pins situated at one end of it should embrace the balance spring, while the other end was rigidly fixed. Now if, at a certain temperature, this strip were absolutely straight, it can easily be seen that on a rise of temperature the brass, expanding more than the steel, would cause the strip to become convex on the brass side, and concave on the steel side, and that if one end were rigidly held, the other would move the curb pins along the balance spring and so shorten it, thus increasing its strength to compensate for the weakening caused in it by the increased temperature. *Mutatis mutandis*, similar effects would occur for a fall of temperature. Harrison also provided that the position of this compound strip, which he called his "thermometer curb," could be shifted bodily so as to adjust the watch for mean time, but he found that this adjustment did not answer, and abandoned it. As we shall see later, this method of compensation is imperfect, and has been abandoned, but in its day it represented an enormous advance. Harrison himself was aware of its defects, and suggested, in a pamphlet I shall notice presently, that the compensation ought to be in the balance itself—as it now is.



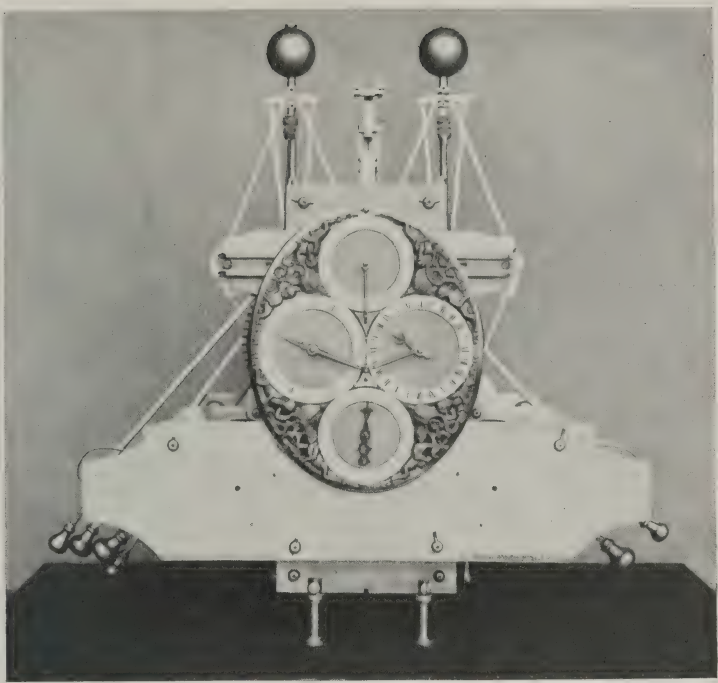
Harrison's compensation

The watch embodying these inventions of Harrison's is a beautiful piece of work, and very costly. It was jewelled wherever possible, to reduce friction, and the top plate and balance cock are a mass of the most elaborate chasing. How much of it is Harrison's own work is uncertain, but his master mind dominates its construction. It is marked "John Harrison and Son, 1759." The mainspring, remontoire spring, and maintaining spring were made by Maberly, a famous London spring-maker, and I think the chasing was the work of a jeweller; but all the elaborate mechanism, including the balance-spring, is undoubtedly Harrison's own work, assisted, of course, by his son. What Harrison himself thought of it can be seen from an unpublished description of it which he wrote, and of which I possess a copy. He concludes his account of the watch by saying, "And I heartily thank Almighty God that I have lived so long, as in some measure to compleat it . . . , and I think I may make bold to say, that there is neither any other Mechanical or Mathematical thing in the World that is more beautiful or curious in texture than this my watch or Time-keeper for the Longitude."

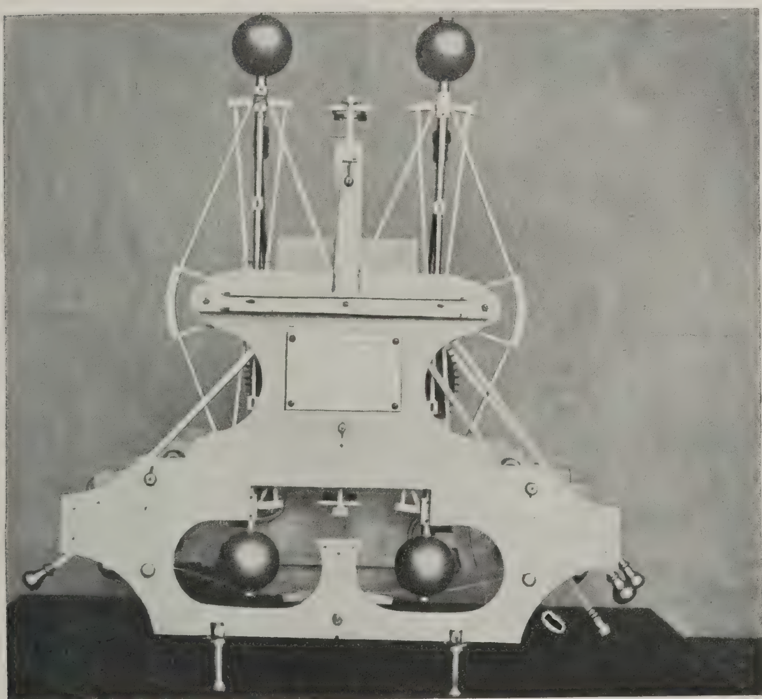
The Astronomer Royal very kindly offered me the loan of this watch in order that I might exhibit it to you, but, with his permission, I chose instead the duplicate of it made ten years later by Larcum Kendall, since the latter is an exact copy of No. 4, and has an added interest by reason of its magnificent performances when tested for several years at sea by one of the greatest of all navigators—Captain James Cook. Here is Kendall's duplicate, and you will observe that it is simply an enlarged watch, and is not slung in gimbals. Although he had used them with his first machine, Harrison subsequently took an aversion to gimbals, and alleged that they caused more errors than they avoided. It is certain, though, that had he employed them for No. 4 he would have annulled one of the few remaining defects of his masterpiece—its varying rate of going in different positions.

Harrison had applied in 1757 for a trial of his third machine, under the Act of Queen Anne, but the granting of this was delayed for various reasons until 1761, by which time No. 4 was finished. As Harrison was now sixty-eight, his son, William Harrison, was allowed to sail in his stead, and he left Portsmouth with No. 4, aboard H.M.S. *Deptford*, on 18 November 1761. After eighteen days at sea the dead reckoning gave the ship's longitude as 13° 50′ W., but by the chronometer it was 15° 19′ W., and William Harrison asseverated so strongly that the latter was correct that the ship, which was bound for Madeira, altered course accordingly, and the island, as he had predicted, was sighted next day. This, as a contemporary account put it, was a matter of relief to the ship's company, who were then in great want of beer.

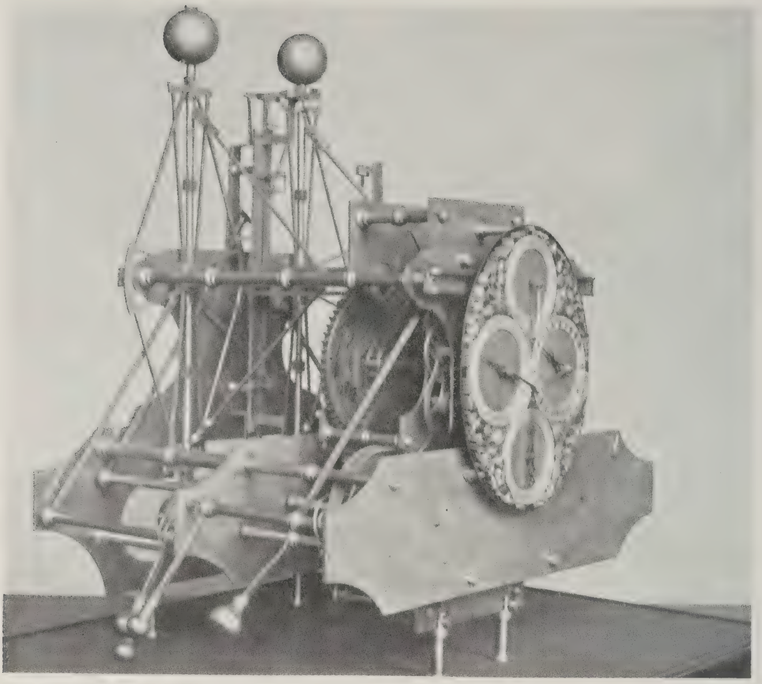
When the *Deptford* reached Port Royal, sixty-one days out from Portsmouth, the watch was found to be nine seconds slow, and on its return to Portsmouth, in very stormy weather, its total error after an absence of



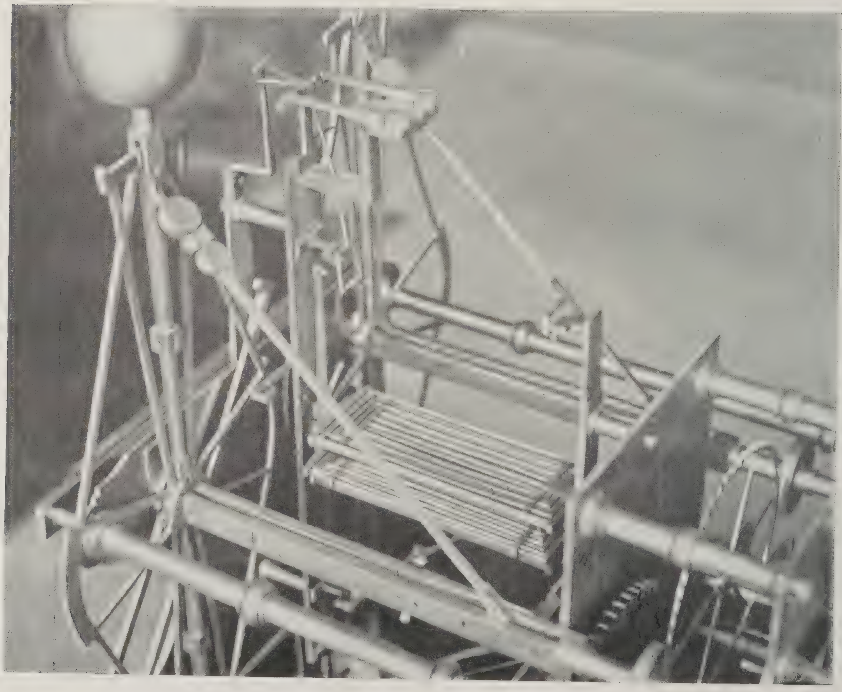
HARRISON'S FIRST CHRONOMETER: FRONT VIEW: DIALS AND HEADS OF BALANCES



BACK VIEW: THE COUPLED BALANCES



HARRISON'S FIRST CHRONOMETER: SIDE VIEW: TRAIN AND BALANCE



THE BALANCES AND GRIDIRON FROM ABOVE

five months was 1 min. $53\frac{1}{2}$ sec., corresponding to an error in longitude of $28\frac{1}{2}'$. Harrison's pride in his masterpiece was not unjustified.

The longitude of Jamaica, however, was then regarded as rather uncertain, and although the Board of Longitude advanced £5000 to Harrison on account of the reward, they demanded a fresh trial of the watch, and accordingly, in 1764, William Harrison and No. 4 were sent in H.M.S. *Tartar* to Barbados, accompanied by Dr. Maskelyne as representative of the Board. Harrison declared the rate of his watch, before sailing, as one second a day gaining. No. 4's error at Barbados was forty-three seconds, and after returning to England its total error, allowing for rate, was fifty-four seconds in a period of 156 days, corresponding to an error in longitude of about 14′—a far finer performance even than its voyage to Jamaica.

Then began a long and bitter struggle between Harrison and the Board of Longitude. Harrison contended that he had complied with the terms of the Act, and demanded the £20,000. The Board pointed out that the winning method, whatever it was, had to be shown "generally practicable and useful," and they demanded that he should first explain, and give drawings of, the mechanism of his timekeeper, also that a copy of it should be made by some other person. After much wrangling and paper warfare, Harrison complied with these conditions, and took his timekeeper to pieces before a committee of scientists and watchmakers nominated by the Board. Even then there was much delay; but in 1765 Harrison was paid another £5000, and finally in 1773, after the personal intervention of H.M. King George III., he received a further £8750, which completed the amount of the reward. The Board, however, entered a silent but effective protest against the finality of his work by immediately procuring the passage of an Act of Parliament offering a further reward of £10,000 for any means of finding the longitude within half a degree. They stipulated that, if this were competed for by a timekeeper, such machine's total error should not exceed four minutes in six months.

The copy of Harrison's watch demanded by the Board was made by Larcum Kendall in 1766–1769. Kendall only contracted to make an exact part-for-part copy, without guaranteeing its performance, and charged £450 for it. This is the watch I have here, and its going, when tried at sea, reflected the greatest credit on both Harrison and Kendall. Captain Cook had it with him in the *Resolution* on his Antarctic voyage, 1772–1775, which, with its alternations of dead calm and furious gales, tropical heat and extreme cold, was as severe a test as could well be imagined, yet so well did the watch perform that Cook remarks in his Journal, "I must here take note that our longitudes can *never* be erroneous while we have so good a guide as Mr. Kendall's watch." He made a special point, also, of asking for this watch when he sailed again in the *Resolution* on his third voyage in 1776. It is curious to note that the accuracy of its going put the Board in the anomalous position of continuing to offer a reward of

£10,000 for a feat which this chronometer in their possession had already shown itself fully capable of performing.

Harrison, while waiting to receive his reward, made a fifth watch, an improved No. 4, which is now in the Guildhall Museum, and in 1775 he published an extraordinary pamphlet called "A description concerning such mechanism as will afford a nice or true mensuration of time." This work, which, unlike previous pamphlets published in his name, was his own unaided production, affords proof of the statement, often made in his lifetime, that it was exceedingly difficult for him to express his ideas, either verbally or in writing. The manuscript of it is in my possession, and, although the handwriting is quite clear, the meaning is often unintelligible.

Harrison, who thus ended his long and laborious life in the enjoyment of well-deserved success and reward, died in 1776, aged eighty-three, and was buried at Hampstead.

Although he had "blazed the trail," his chronometer was superseded almost immediately by others of simpler design. Only two men followed in his footsteps, Larcum Kendall and Thomas Mudge. Kendall, as we have seen, made the copy of No. 4 which performed so well, and he then tried his hand at simplifying Harrison's construction. He made two attempts at this, one of which was the famous chronometer stolen with the *Bounty*, and recovered fifty years later in Chile, but neither was so good a timekeeper as his copy of No. 4. The *Bounty's* chronometer, which, by courtesy of the Secretary of the Royal United Service Institution, I examined a short time ago, is simply a large ordinary watch, with a compensation curb, but no remontoire. It is still in going order. Kendall's second attempt, now at Greenwich, is a watch with a peculiar escapement of his own designing, and he afterwards made a beautiful little pocket-chronometer, now in the Guildhall Museum, in which he reverted to the principles of No. 4 and fitted a remontoire.

Far more important, in the history of the chronometer, is Thomas Mudge, a London maker who devoted the last twenty years of his life to improving marine timekeepers. He was a gifted horologist and a most amiable man, but his chronometer, beautiful piece of mechanism though it was, proved far too complicated. It may be described as an over-developed No. 4. Harrison's watch went for a day, Mudge's for eight days: No. 4 had a single balance spring and compensation curb, Mudge fitted two of each: Harrison's remontoire was wound eight times a minute, Mudge's machine had two remontoires, each wound up three hundred times a minute: lastly, Harrison's workmanship was good, but Mudge's was exquisite.

His movement embodies two balance springs, one for regulating and one for compensation. Two small spiral springs form the remontoires, and they are alternately wound by the escape wheel and unlocked by the balance. The upper and lower ends of the balance staff run

between friction wheels. Adjusting this escapement was no simple matter, but the weak spot of Mudge's chronometers was not so much that as the defective, although ingenious, compensation.

It is due to Mudge's memory to say that he planned his chronometer before becoming acquainted with the details of Harrison's. He built three of them, but, although repeatedly tried at the Royal Observatory, they did not satisfy the new conditions imposed by the Board of Longitude. He finally petitioned Parliament for a reward, and, in spite of the Board, was awarded £3000. He died in 1794. Mudge's best title to fame is that he was the inventor of the detached lever escapement, now almost universally employed in watches.

But Mudge was passed in the race by other competitors. Foremost amongst them, and second only to Harrison himself, is Pierre Le Roy, a Frenchman, and the true father of the modern chronometer. In 1766 Le Roy presented to King Louis XVI. a marine chronometer of his invention, embodying all the main features of a present-day one. It was suspended in gimbals, which removed all errors of position, and had a single dial showing hours, minutes, and seconds, the hour-hand turning to the left.

The machine really consisted of an enormous balance, weighing about 5 ozs., with a comparatively small watch-movement to keep it swinging. It was suspended by a thin piece of harpsichord wire, and kept in position by friction-rollers. This suspension is very delicate, but fragile, as is shown by the fact that while Le Roy was posting down to Havre with two of these chronometers for trial at sea, the wire of one balance was broken by the motion of the carriage. Nothing daunted, however, he fitted a new wire at his inn that night, and reached Havre with both of his chronometers going.

Le Roy was the discoverer of the fact that any balance spring can be made practically isochronous—that is, able to make the balance describe long and short arcs in equal times—if it be of one particular length, which can be found by experiment. Accordingly he abandoned the use of a compensation curb, which acts by altering the length of the balance spring. Also, having obtained an isochronous spring (or springs, for he used two), it was unnecessary to employ either a remontoire or a fusee, since variations in the driving force might alter the arc described by the balance, but could not affect its time of describing them. Consequently he fitted his chronometer with what is called a "going barrel," now used in almost all watches, in which the mainspring acts on the train of wheels with a force varying directly as its tension.

His escapement, too, was a tremendous improvement on Harrison's. It was "detached": that is to say, it left the balance free to swing, except for the moment when it was unlocking the escapement and receiving impulse. Lastly, he put his compensation in the place where, as Harrison pointed out, it ought to be—in the balance. He invented a balance

composed of brass and steel strips, which we shall afterwards find Arnold and Earnshaw using, but he finally devised and adopted a very ingenious one which had two thermometer tubes filled with mercury and alcohol, and so arranged that a rise of temperature diminished the inertia of the balance in such a proportion as to compensate for the weakening of the spring, and *vice versâ.* A similar balance was successfully used, long afterwards, by an English maker named Loseby.

Le Roy's chronometer, which is preserved in the *Musée des Arts et Métiers* at Paris, was tried at sea, with another like it, in 1767 and 1768, and their performances in both cases were extremely good. Le Roy, however, never received such public recognition or reward as had been granted to Harrison. As M. Gros, in his excellent treatise on 'Escapements,' has indignantly remarked (I translate), "Harrison, for the invention of a mechanism which was abandoned almost immediately, received £20,000: the Frenchman of genius, who has added one more to the glories of France, received—a medal."

Since Le Roy's chronometer was completed before any particulars of Harrison's work had been published, its design was entirely original, and reflects the very greatest credit upon its inventor.

Contemporary with Le Roy was his great rival, Ferdinand Berthoud, who also devoted many years to the improvement of chronometers. He is chiefly remarkable for the extraordinary variety of his conceptions. Some of his chronometers were controlled by a balance; some by two balances geared together; one by a pendulum. Some were driven by weights, and some by springs. Some had compensation curbs, some compensation balances; at least one had both. Some had cylinder escapements, some detent escapements, and some were fitted with modifications of various other patterns. Some were fixed, some slung in gimbals; some had their dials vertical, some horizontal, and the dials themselves exhibited many differences of arrangement. Berthoud's industry and inventiveness were amazing (he was also, in his spare time, one of the most voluminous writers on horology who ever lived), but his work does not exhibit quite the scientific thoroughness or the perfect adaptation of means to ends which characterize that of Le Roy.

I regret very much that I am unable to show you portraits of either Le Roy or Berthoud, but I have here a little chronometer by Berthoud. It is an early one, No. 37, made about 1785. It is still a good timekeeper, and in one or two points I prefer it to a modern chronometer, since you can wind it without turning it upside down, as you have to do nowadays; you can lock the balance in a moment without doing it any injury, and you can set the hands to any hour, minute, and second you like while the chronometer is going. It has a compensation curb *and* a compensation balance. The escapement is a detached one—a pivoted detent.

But at the same time that Berthoud was making machines such as this, the mechanism of the chronometer was undergoing its last important

development at the hands of two Englishmen, John Arnold and Thomas Earnshaw. These two were contemporaries, and hated each other cordially.

John Arnold was for some time a gunsmith, and first made his mark in London as a clockmaker in 1765, when he presented to H.M. King George III. an extraordinarily small watch, which was the size of a silver two-penny piece, and weighed 127 grains. In spite of its absurdly small size it was a half-quarter repeater. He turned his attention to chronometers, and three of his early efforts were sent aboard the *Resolution* and *Adventure*, on their Antarctic voyage, for comparison with Kendall's copy of Harrison's No. 4. Two of these are in possession of the Royal Society, who have kindly permitted me to exhibit them. They have compensation curbs, like No. 4, and most peculiar escapements, which are quite unique, and impossible to describe briefly. They were not good timekeepers, and Arnold set about making better ones.

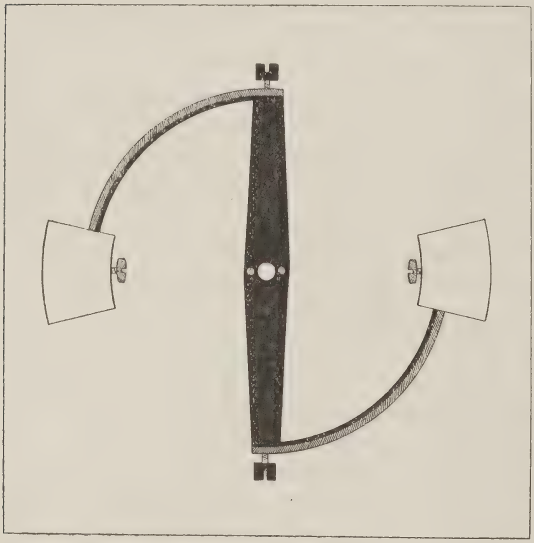
And here it becomes difficult to distinguish between his work and that of Earnshaw. Both men brought out forms of compensating balance, and of detached escapement, substantially resembling each other. Arnold patented a compensation balance, which he subsequently abandoned, in 1775, and took out a patent for his final form of escapement in 1782. Earnshaw never patented his balance, but took out a patent for his escapement, or, rather, got a maker named Wright to patent it for him, in 1783. So that in point of priority Arnold's patent was a year ahead of Earnshaw's. On the other hand, Earnshaw repeatedly asserted, once in Arnold's presence and that of the Lord Mayor, that Arnold had learnt of his invention from a maker named Brockbank, and filed his specification a week later; and to this challenge Arnold never made any public reply.

Nowadays it is possible to admit the merits of both men without further probing this vexed question, which is essentially this—either the inventions were independent or Arnold borrowed from Earnshaw. As the improvements made by both men had much in common, and those of Earnshaw became the standard, I will not confuse you by illustrating or describing Arnold's. He never entered any chronometers for public trial at Greenwich, but—and this is the important point—he established a manufactory of them at Chigwell in Essex, and so for the first time made them available to seamen generally. This was a service the importance of which is hard to over-rate. No longer were chronometers to be the jealously prized possession of a few chosen navigators. In 1799, when Arnold died, he and his men had made over one thousand good chronometers, and Earnshaw upwards of five hundred, and never again was there to be any need for ships to run the risks they had done even twenty years before.

The Board of Longitude paid Arnold, at various dates, £1322 in recognition of his valuable work, and in 1806 they made it up to £3000, paying the balance to his son, John Roger Arnold, who succeeded him.

Thomas Earnshaw, Arnold's rival, was born in 1749. From all

accounts, he was an independent and straightforward man, somewhat abrupt and unpolished in his manner, but a consummate horologist. He worked his way up from the position of a watch-jobber to that of a chronometer manufacturer. In 1783, as we have seen, he introduced his new escapement and balance. The escapement's action is very simple, yet in the hundred and forty years since he invented it no better one has been devised, nor is it easy to see how it could be simplified or bettered. A tooth of the escape wheel is locked by a detent mounted on a spring, which carries a second small spring on its tip. As the balance swings, a projection on a roller mounted on the balance-staff engages with the small spring, which presses on the detent-spring and bends it slightly, thus releasing the tooth. The escape-wheel promptly turns, and in so doing another tooth falls on a stone fixed in the roller and gives the balance an impulse. The detent-spring resumes its position, and the next tooth locks on it. As the balance swings back, the projection again hits the small spring, but this now merely gives way to it, and the tooth remains locked. This escapement is the best known for use in chronometers. It only gives impulse in one direction, and is not self-starting.



Earnshaw's balance

Arnold's escapement was very like this, except that the escape-wheel turned the other way, and the detent unlocked by moving inwards. J. R. Arnold, however, is known to have admitted, in private conversation, that Earnshaw's escapement was the better, and after the latter's death in 1829 he adopted it. Still, Arnold's was a perfectly adequate escapement. I have a pocket chronometer fitted with it, made about 1815, which is an excellent timekeeper, though subject to the defect of all watches with a chronometer escapement, that any sudden jerk may stop them, and they will not start themselves. The lever escapement, on the other hand, is self-starting, hence its practically universal employment in watches. It would be used in chronometers, too, but for the fact that it needs oiling, and that the ageing of the oil affects its performance. The chronometer escapement needs no oil.

In Earnshaw's balance the curved arms are made, like Harrison's "thermometer curb," of brass and steel strips, not riveted, but fused together, the brass outside. As the temperature rises, the weights are brought slightly nearer the centre and so decrease the inertia of the balance. The two small screws are for mean time adjustment.

Earnshaw was paid £3000 in 1806 as a reward for his improvements. But he was much dissatisfied with this amount, and in 1808 issued a pamphlet called 'Longitude—An Appeal to the Public,' in which he stated his grievances. This work, although perfectly honest and candid, and containing valuable information, is a masterpiece of unconscious humour. For instance, he winds up an impassioned apostrophe to the Hydrographer of the Navy with the delightful peroration, "Do this, and Earnshaw is your friend"!

And at this point the history of the chronometer, as far as the development of its mechanism is concerned, practically terminates. It is, indeed, a conclusive testimony to the finality of Earnshaw's work that one of the greatest mechanicians who ever lived, Abraham Louis Breguet, could find practically nothing in the chronometer, as he left it, which would bear improvement. Breguet devised an exceedingly delicate and beautiful remontoire escapement, which he used in some of his chronometers, but which gave no better results than Earnshaw's; and he showed his extraordinary power of cutting the Gordian knot of a mechanical difficulty by producing a mechanism which entirely did away with the position-errors of pocket chronometers. This he did by a device which he called a "tourbillon," and which provided that the escapement gradually revolved in a circle, and consequently had no fixed position.

But, generally speaking, the transformation of the chronometer, from a possibility to a commercial actuality, took place between the years 1761 and 1785, and later makers have more or less accepted the mechanism of the chronometer as Earnshaw left it, and devoted their energy to improving the compensation. For the simple compensation balance devised by Earnshaw can only be absolutely correct at two particular temperatures. Between these a chronometer with that compensation will gain, and outside them it will lose. Several devices, however, have since been introduced which more or less surmount this defect.

Here I must finish my sketch of the chronometer's history, and, in concluding it, let me express the hope that, in whatever manner the future history of the chronometer and its makers may be affected by the recent developments of wireless time signals and wireless direction finding, it may be many a long year before the chronometer as a means of finding longitude is superseded, and that even when Macaulay's New Zealander, in years to come, visits the ruins of Greenwich Observatory and finds the chronometer-room long deserted and forgotten, there may yet be some living who still remember the little band of men who bequeathed us the

chronometer of to-day—Le Roy, Mudge, Berthoud, Arnold, Earnshaw, and, above all, John Harrison.

Before the paper the PRESIDENT said: I have much pleasure in introducing to you Commander Gould, one of the staff of the Hydrographer at the Admiralty, who has for a long time past taken a special interest in chronometer construction.

Commander Gould then read the paper printed above, and a discussion followed.

The PRESIDENT: The Hydrographer of the Navy has honoured us with his presence, and we shall be indebted to him if he will open the discussion.

The HYDROGRAPHER: I think we have all listened with very great interest to this lecture, which is somewhat technical, and perhaps some of those present did not quite understand all the points; but I would like first to say this, that we are extremely fortunate for the permission which has been afforded us for Lieut.-Commander Gould to give his lecture under the auspices of the Royal Geographical Society. It is apparent, I think, that a great deal of research and study has been compressed into a comparatively short lecture in order to cover so much ground going back over two hundred years, and that has only been possible by the assistance of those interested in horology; and I should like to say how very much we are indebted to the Astronomer Royal, for it is only by his extreme courtesy that we are able to see all these very delicate and extremely valuable instruments. The archives of the Royal Observatory have been carefully studied, and much has been included in the interesting form of this paper. It is quite true to say this, that when we go back to such a period as one hundred and fifty years ago—and it can be amply borne out by complete evidence—many longitudes determined by Cook's chronometers stand to this day without material alteration. There were no submarine cables or wireless telegraphy in those days, and voyages occupied generally four years—to this day those longitudes remain practically as they were then determined, and it is due to the workmanship of these chronometers which we have seen, one of which was actually on board the *Resolution*, that such results were possible. Coming to a later period, it is the same on the coast of South America, particularly Chile and Peru. So much for the past. Dealing with the almost immediate past (I refer to the epoch during the war), there is a point which may perhaps not have struck you, and that is the immense number of chronometers then made and the very large number lost by sinkings. Many of the chronometers made in this country were by people not necessarily bearing English names, and our then enemies were responsible for very good chronometers of high workmanship. We reached a position towards the middle of 1917 when they were of extreme value. There were not enough to go round, and the Admiralty had perforce to ask those who possessed chronometers, perhaps of great age and history attaching to them as family heirlooms, to lend or dispose of them to the Admiralty. These were, in most cases, of quite good workmanship and only required cleaning, and they were used and "did their bit" in the war. The response was very cordial, and many owners had already volunteered in this way. The difficulty in obtaining chronometers is not being able to turn them out quickly. The war thus produced a severe strain on British enterprise, but we were able to meet all requirements, largely through the good help afforded by the Astronomer Royal and his able staff, for it is not sufficient to manufacture chronometers—they have to be rated and put in proper working order at Greenwich Observatory before they can be issued. Dealing with the future, I think the lecturer alluded very briefly to wireless

telegraphy, which it might be considered at first almost does away with the necessity of ships carrying chronometers. That is not quite so nor likely to be, though I make a guarded statement. In the Navy we have not reduced the number of chronometers carried, and there is no intention of doing so at the present time. It is quite true to say that the introduction of wireless telegraphy, as applied to time keeping, very much facilitates the use of chronometers on board ship, and the difficulty of rating is very much simplified ; but it will probably be many years before we shall see any diminution of those chronometers carried on board, notwithstanding that it is obligatory for most ships to carry an outfit of wireless telegraphy. It is possible now, each day, for all those who have these instruments and receiving apparatus and are within range—by means of the Vernier time signals sent out from the Eiffel Tower—to accurately determine errors easily within one-hundredth second of time, by this delicate method, which I have no doubt many here are familiar with. By means of a chronograph and relay you can reduce that error to something very much less, and the difficulties of interference such as atmospherics and jamming are largely surmounted. There is not very much literature on this subject. We have Captain Shadwell's 'Notes on the Management of Chronometers,' which is sixty years old now, but there is not very much published of a standard type, and I throw out the suggestion to Lieut.-Commander Gould, that perhaps he might be able to follow up his researches, and put into practical form something more in the shape of a history than what we have listened to with so great an interest this afternoon. I am sure, as Lieut.-Commander Gould has told me, you will appreciate it is extremely difficult to go searching for data in all likely quarters, and of necessity you miss many points, and the links are getting more difficult to connect year by year.

The ASTRONOMER ROYAL : Commander Gould has given us a paper on, I think we shall all agree, a very attractive subject, and we shall all further agree he has treated it in a very attractive manner indeed. I think he is particularly well suited to give a lecture on the chronometer, because he combines the taste for historical research with the gift of the manual dexterity, the love of taking instruments to pieces, absolutely necessary to any one who is going to read in an interesting manner, and thoroughly understand such a complicated instrument as the chronometer. The Hydrographer spoke of Commander Gould as being indebted to us at the Observatory, but, to tell the truth, the boot is actually on the other foot, and we are deeply indebted to Commander Gould. It is a very good thing to begin with to find a man thoroughly interested in the history who will go over the records. I suppose there must be many places where there are valuable records, and it does not fall into the province of the people to examine their old records. We owe to Commander Gould the restoration of this extremely beautiful and valuable instrument which you see here. I hardly like to tell you how bad a condition it had got into after a number of years, but Commander Gould took it, and after taking it to pieces—it took him many months to do—you see what a beautiful instrument he has made of it. It is very desirable that this instrument, which is of the greatest historical value, should be kept in a nice state of preservation, and I can say I am very greatly indebted to Commander Gould, and will take good care that the instrument does not get into a bad way again. This was all done with his own hands. I should like to say how heartily I sympathize with the remark which the Hydrographer let fall, that this lecture will only be the summary of the principal points in the history of the chronometer, and that Commander Gould will write a more complete and fuller history of it. He is

well qualified for such a task, and it would be a very interesting thing to have the whole story of Harrison and Earnshaw and Arnold all put down in a book. One point which struck me particularly, I did not know it before, was the high position Le Roy held and how early he was in the field. It is extremely interesting to hear that the French were so very little behind Harrison. Commander Gould did not mention anything about the astronomers' method of finding longitude by lunars, but I should have thought that in their long voyages when they went to Australia they would not trust entirely to their chronometers. The Hydrographer has said we have a rival in the way of wireless signals. I think they may very well act in the way of getting for us generally increased accuracy, and the chronometer will be used alongside them, and the rate will be perfectly well known. The Hydrographer spoke about the German chronometers. Curiously enough, we had given to Greenwich the chronometer from the *Emden*, and it had a German mark on it, but when we examined it we came to the conclusion it was made in Clerkenwell. I do not know that I have anything more to say except how much I have enjoyed Commander Gould's lecture.

Mr. A. R. HINKS: We have all been admiring these beautiful specimens of workmanship of John Harrison, and I should like to remind those interested that there is an equally beautiful and even more delicate example of his work in the possession of the Royal Astronomical Society. For a good long time the Society had standing in the assistant secretary's room the Harrison clock, which within memory had never gone. It had been submitted to various clockmakers, who had always proposed to scrap the escapement and substitute something more modern. Happily that had always been resisted by the Society, and at last, some years ago, Mr. Cottingham, a very distinguished clockmaker, who is now, I believe, engaged in making the new standard clock for the Royal Observatory, undertook as a labour of love the restoration of the Harrison clock of the most marvellous workmanship, and with the very interesting grasshopper escapement that Commander Gould mentioned just now. It stands in the rooms of the Astronomical Society, and I feel sure any one interested in perfecting his knowledge of Harrison's work would be welcome to see the clock, which is arranged with mirrors and lit inside. Sometimes it is working and sometimes it is not. It has that very refined escapement; and although Mr. Cottingham makes it go for several months at a time, one has to admit that it does stop, and has to wait for a visit from him, because nobody else is sufficiently bold to tackle it.

The PRESIDENT: We are much indebted to Commander Gould for giving us this history of the chronometer. At sea we are so accustomed nowadays to using these chronometers, and even we on land, in our explorations have to use pocket chronometers, that we have come to take them as a matter of course. So it is very pleasant to be reminded of the enormous value they are to us and of what the poor unfortunate navigators in the old days before they had these advantages had to go through. We should like in this Society to give credit to and remember the names of those who, in the old days, through their genius, have given us the advantages we now enjoy. I do not know whether Earnshaw did succeed in getting the friendship of the hydrographer of the time, but I am sure all future hydrographers will be glad to give him their friendship. We should like now to give a hearty vote of thanks to Commander Gould for collecting this information and giving us such an admirable and most attractive paper, and I should like to add my hope to that of the Hydrographer and of the Astronomer Royal that he should develop it into some larger and more permanent record.

THE MOUNT EVEREST EXPEDITION: ORGANIZATION AND EQUIPMENT

By Members of the Expedition and of the Committee

Addresses delivered at the Meeting of the Society, 7 March 1921.

The Object of the Expedition.

Lieut.-Colonel Sir FRANCIS YOUNGHUSBAND, President of the Committee.

WIDESPREAD interest has been aroused by the announcement that the Alpine Club and this Society are organizing an expedition with the object of ascending Mount Everest. From many different countries came applications to take part in it. But yet I am also being continually asked, What is our object in climbing the mountain? What shall we do when we get to the top? What do we expect to get there? Who will be a penny the better for our having reached the summit? I was even asked on the telephone by an enterprising journalist to tell him for the benefit of his paper "what good there would be to the general mass of humanity in the ascent of Mount Everest."

I had better once again answer such questions, for it is important that people should have no doubt or misgivings in their minds as to the good which will accrue, even to the general mass of humanity, from the ascent of Mount Everest.

A porter on an underground railway may be considered as about as representative as any we can find of the general mass of humanity. The other day I heard of one who laid it down as an absolute certainty that we could never reach the top. He had been with us in Tibet and had seen these Himalayan peaks. And "they might take it from him that the top of Mount Everest would never be reached."

Now if the human race had always acted in the spirit of the general mass it would never have emerged from the primeval forest. We should be still timid uncultured people hiding in caves and the forest depths. Fortunately, however, there were always daring leaders who struck out ahead of the general mass. They ventured out into the open plains, on to the rivers, on to the sea, even up into the air. And it was an uncommonly good thing for the general mass that they did. The leaders with spirit and imagination showed the way. The herd were glad enough to follow after and pick up all the benefits. But the mass would never have had those benefits if there had not been leaders to give the lead. Very often these leaders did not survive. The fittest to survive were those who stayed at home. But they led the way, which is a good deal better than surviving. And men must always look for leaders who will venture as they did.

Now the human race does not like to leave any spot in this little planet of ours unvisited. And for thirty years, at least, that is since General

Bruce first put forward the idea, men have had the ambition to ascend the highest point on the Earth. It is a very natural and praiseworthy ambition; General Rawling and many of the Alpine Club have entertained it. Lord Curzon also intended to further this ambition and suggested, when he was Viceroy of India, that this Society and the Alpine Club should take the matter up together. And the advantage that will come from ascending Mount Everest is this—that once the highest peak has been climbed men will pluck up courage to ascend all manner of other mountains. Even to the obtuse mass of humanity it will then be evident that men are capable of higher achievement than they had ever imagined.

As to the advantages of mountain climbing in general a Frenchman a few days ago bore striking testimony. Speaking here in London at the Institut Français, M. Léon Bérard, Minister of Public Instruction, told how his countrymen had shared with Chateaubriand a dislike of mountains, but that the example of the English cured them of their prejudice and revealed to them in a new way the beauty of their country. M. Bérard was referring more particularly to his own part of France at the foot of the Pyrenees.

We acknowledge with gratitude the graceful compliment of the Frenchman. But we shall not be so immodest as to appropriate to ourselves alone the credit of discovering beauty in mountains. For others besides ourselves—and those others include many a Frenchman—have made the discovery that by going in among great mountains, climbing them, getting to know them thoroughly, entering into their spirit, there are beauties to be found in mountains of which the plainsman never dreams.

So the ascent of Mount Everest, by stimulating mountain-climbing in general, will bring more beauty to light. And beauty is one of the world's richest riches. We cannot expect that on the instant the general mass of humanity will suddenly derive good from the ascent. But we can be perfectly sure that in the long run even porters on underground railways will find their blood stirring more quickly with the sense of high achievement, and will feel life richer for the new beauties which have come into it.

The Approach to the Mountain.

Prof. Norman Collie, President of the Alpine Club.

Before I say anything about the reconnaissance I should like to supplement what the President has said about the uses of this expedition. The expedition will have to explore new country of the highest importance, not only high because it is high above the sea-level, but because it holds the finest mountain range in the world. Geologically, it is necessary to know how the rocks and the strata are lying round this great peak Everest. Then, botanically, there is no doubt that a number of Alpine plants that grow at very high altitudes—18,000 to 20,000 feet—will be brought back. The authorities at the Natural History Museum have assured us that if the expedition will only catch all the small mice,

SKETCH-MAP OF THE MOUNT EVEREST REGION SHOWING REVISED ROUTE OF THE EXPEDITION

MOUNT EVEREST AND THE MOUNTAINS TO THE NORTH, PHOTOGRAPHED BY DR. KELLAS IN DECEMBER 1920 FROM A HEIGHT OF 16,350 FEET NEAR THE KANG LA

Note: the peak B has been retouched by the engraver and made much too prominent

rats, and other rodents that they find on these high plateaux, at least sixty per cent., and possibly more, will be new to science. I do not think a more interesting expedition could possibly be made, and it is to be carried out at a cost much smaller than that of any big expedition I know; therefore I think the public should recognize this and support it. It does not matter how much they give, in one way, as long as they give something. Five thousand pounds is easily made up by ten shillings each from those interested.

Proceeding now to the reconnaissance of Mount Everest; I thought first it would be moderately easy. At the meeting when General Bruce addressed you in November, Captain Longstaff said you have to find Everest first, and I thought it rather an unnecessary remark: a mountain of 29,000 feet could not be mistaken. But from information that has been sent by Dr. Kellas, I am beginning to think there is more in what Captain Longstaff said than at first appeared. The expedition will start from Darjeeling into the Chumbi valley, and over the passes thence into Tibet. Between Kangchenjunga and the great mass of Everest and Makalu is the great valley of the Arun river, draining all the country at the back of the mountain. Undoubtedly there is a route up the Arun valley over to Tibet, and the higher up you join the main route the better.

Prof. Collie then discussed some telephotographic pictures of Mount Everest and the mountains to the north taken by Dr. Kellas in December 1920 *from the neighbourhood of the Kang La on the ridge running north from Darjeeling, with an approximate identification and location of the various peaks attempted by Dr. Kellas. These photographs were taken from the point to which Mr. Freshfield directed attention in his account of his Kangchenjunga expedition, as a point from which the Survey of India should photograph the country. From this material Prof. Collie concluded that there are two principal valleys running up to Mount Everest, one on the north, and one on the north-east, and that the approach must be by one of these, the western side being apparently very steep.*

The Plans of the Expedition.

Colonel Howard Bury, Chief of the Expedition.

The expedition is to start shortly, and during the last few weeks we have been busy in making preparations and trying to collect stores and equipment. Part of the expedition may have to live at great heights for a considerable time, and one has been experimenting with small details such as primus stoves to burn at over 20,000 feet. You cannot keep fit unless you have good and hot food. It is of the very greatest importance to have food easily digestible, which can be easily warmed up at very great heights. The expedition has been organized by Sir Francis Younghusband, and to him has been practically due the fact

that it has been brought into being. His energy here and his work with the various authorities have brought the expedition into being. The main object of the expedition is the ascent of Everest. But besides that, as Prof. Norman Collie has said, there are some very important subsidiary objects to be attained. The whole country to the north of Everest is completely unknown. The maps we have are all very problematical, and where you see a range of mountains marked in the map you may find it is a valley or lake, and as we go along we shall have to map our way. The Government of India have very kindly given us the loan of two officers of the Survey of India, both accustomed to mountain survey, and with them we shall have to work and map the whole of that country to the north of Everest, as well as the Mount Everest group; this alone would furnish a full summer's work. With these officers will be assistant surveyors, and a great deal of work has to be done. The Arun valley is probably quite wrongly mapped, and we are very doubtful as to the exact position of those ranges of mountains marked to the north of Everest. The draughtsman who compiled the map told me they were put in to fill up! Now Mount Everest is becoming known, like many other places at one time unfamiliar, as the island of Yap came into prominence a few days ago. I heard two ladies discussing the expedition recently, and at last one said to the other, "And where is Mount Everest?" "Oh, somewhere in Iceland"! Another remarked to me, "Oh, how very interesting your going to Everest! I hope you may get to the top, and then you may bring back a piece of wood from the Ark." We have a good botanist and naturalist, and there is every probability of our discovering many new flowers; but that very much depends on how far the monsoon currents penetrate up the Arun valley. It is extraordinary on those dry plains, which look so barren in the photographs, what beautiful flowers there are—most lovely rock plants, blue poppies, primulas, and all kinds of delightful flowers. There is also the geological work. We are probably getting either an officer or assistants from the Government of India for making a geological collection. We know there are a large number of animals up there. You get Ovis Ammon, one of the largest sheep in the world; possibly an antelope, certainly a gazelle, and partridges, and there is a great field for a naturalist. Some of the members of the expedition are leaving very soon, and we all hope to collect in Darjeeling in the middle of May, and to leave by the 14th. The Government of India is kindly giving us the loan of 100 mules for the expedition. This will be of the very greatest assistance to us, and we know now we shall have no difficulties with the transport. Lord Ronaldshay, the Governor of Bengal, is extremely interested in the expedition, and we are lucky in having him there. Colonel O'Connor is Political Agent in Sikkim, and his duties carry him right up into Tibet. He was with Sir Francis Younghusband in the expedition of 1904. It is, therefore, a specially favourable time for us to make this expedition, with so many

friends who will be quite ready to help us. There is a very elaborate photographic equipment going out with the expedition, so that we hope to bring back many records. Unfortunately the camera cannot reproduce the extraordinary beauties of colour there are in Tibet—greens, and reds, and orange, under a brilliant blue clear sky. It is a wonderful expedition, full of interest of all kinds, and when we come back I hope we shall have a very interesting tale to tell you.

The Mountaineering.

Mr. HAROLD RAEBURN, Leader of the Mountain Party.

Seeing that the political difficulties in connection with this expedition have been so happily overcome, we shall hope that difficulties of approach, that Prof. Norman Collie has described as very great, will also be successfully overcome owing to the careful organization of the transport, which is really the secret of getting a large party up there. There remain the mountaineering difficulties, and these will undoubtedly be extremely great. No one has ever seen the real approaches to Everest, because its lower slopes have been always concealed by the shoulders and slopes of its mighty neighbours. I do not think the northern ridge will prove at all possible, because I do not think anybody can live at such enormous elevations for such a long time as would be necessary. I was privileged last year, by very kind permission of the authorities of India and Nepal, to make a reconnaissance of Kangchenjunga, and I think in studying passages and probable conditions, we can, to a large extent, depend upon analogy. Great snow mountains are great snow mountains all the world over. These two great constellations of peaks, Everest and Kangchenjunga, at no great distance apart, are separated by an enormous river valley, the Arun, but probably conditions are very much the same. I think it very unfortunate indeed that for political reasons alone we are precluded from taking the easiest route from the south. We must find some sheltered face route, and I believe that the north east will be the most favourable, for this reason, that the north-west is probably much steeper, and it has the cold aspect. Now altitude and cold are the two great things we have to struggle against. If we can get on the north-eastern side we shall be much more likely to have sun early in the morning. As regards the actual mountaineering, everything will depend upon the training of the coolies, for I do not believe that Europeans can carry at these heights. Above 21,000 feet one has to have really well-trained and young active men, and support them in every way. We may take it that this year will be reconnaissance first of all, but there is no doubt we shall try to get as high as we can, for Italians and Norwegians are ahead of us at present in altitude records. We intend anyway to do our very utmost to explore this great mountain so far as may be possible, and to justify Sir Francis Younghusband's keen interest and able generalship which has rendered it possible.

Mr. Raeburn then showed and described some pictures taken on his reconnaissance of Kanchenjunga in 1920.

The Scientific Equipment.

Colonel E. M. JACK, Member of the Committee.

After all the interesting news you have heard I shall not bore you with a long list of scientific instruments that are being taken, but just tell you shortly what is being provided, with one or two points of interest in connection with the apparatus. We have taken, and are taking, every possible precaution to ensure that the best possible apparatus is obtained. Every precaution that critical examination and report by competent authorities can give is being taken.

We are sending one George mercurial barometer, with spare tubes. The only special point is that as it will not come into action until the expedition gets to high altitudes, we are having it made in a special form, with a much shorter column than usual. The aneroid barometers have, of course, to read to a great altitude. It is not convenient for an aneroid to read for more than 8000 feet in one revolution of the hand. Therefore they are being made in pairs, one to read from 15,000 to 23,000, and the other from 22,000 to 30,000. Small pocket aneroids are being provided for the climbers, and a larger pair as a reserve. The ordinary equipment of maximum and minimum thermometers and of boiling-point apparatus is being taken. Another instrument is a black bulb solar radiation barometer. We asked the views of the Meteorological Office about this black bulb thermometer, how high it should be graduated. The Meteorological Office gave it as their considered opinion that it ought to be graduated up to 220°. Later on Mr. Hinks met an official of the Meteorological Office, and was rather taken back by being told that in his opinion nobody but a fool would take a black bulb thermometer at all; so you see expert advice sometimes has its drawbacks. The optical instruments are one good telescope of new form, the micro-telescope, a good equipment of binoculars, and one or two monoculars. The photographic equipment consists of three stand cameras—one $7\frac{1}{2} \times 5$ and quarter plates—provided with tele-photographic attachments. The National Physical Laboratory, I should say, are giving every possible assistance in the selection. They have been very good in advising us and making a critical examination of the lenses we are sending them, and we shall be guided by their advice. A certain number of hand cameras are being provided: a quarter-plate hand camera, and a panorama camera, and small vest-pocket cameras. The vest-pocket cameras are for the high climbers. We are providing dark room equipment and the usual outfit in that way. I should mention that the plates for the expedition are being given very generously by the Imperial Plate Company. One word about survey. We are not providing any survey equipment at all, because the Survey of India have made

themselves responsible for all survey. It seems a peculiarly favourable opportunity for employing photographic methods. There are three principal ways in which they can be used to supplement the ordinary survey processes. The first is by photographs from the air: that method we shall not be able to use on this expedition, because it would have entailed the formation by the expedition of a special aerodrome, and the funds could not run to it. The second method is by the taking of individual photographs from fixed points on known bearings. That means the employment of a rather special form of camera. This has been used a good deal in Canada, and as Captain Wheeler, who is one of the survey officers, is a Canadian and we have heard he is getting apparatus in Canada and is an expert in photographic methods of survey, there is no doubt that that method will be employed on this expedition, mainly as a supplement to the ordinary method of survey. The third method is that of stereoscopic survey. Photographs are taken in pairs, on parallel lines at the ends of a measured base. The objects represented are slightly displaced in relation to each other, and by measuring the amount of displacement, and with your knowledge of the length of the base and the direction from which the photographs are taken, you can obtain the position and heights of the objects photographed. That is a very suitable method. Whether the Indian Survey will employ this method I do not know at present. An Indian Survey officer has employed the method in India, but he is not to be on the expedition.

Stores and Equipment.

Mr. C. F. Meade, Member of the Committee.

The most natural thing to do in discussing the equipment is to compare this with a Polar expedition, and there are one or two important differences. First of all, perhaps the most important enemy we have to contend with is the sun, and the sun at high altitudes is a very formidable enemy indeed. To cope with this we are having sunproof material to put over the tents, and we are using Whymper tents, with a double fly, which have been proved to be the best tent for high altitudes. Another great difficulty is that at the same time you are suffering, as it were, from chronic sunstroke you are undergoing danger of frostbite, and the boots, therefore, are by no means the least important item in the equipment. The pattern of ski boot is the best, as it gives plenty of room for the feet and for circulation. Covers are used over the boots to prevent them from coming into direct contact with the snow. One of the most encouraging pieces of news I have had is the account of Captain Morshead and Dr. Kellas, who reached the saddle of 23,500 feet on Kamet this year without any suffering whatever, and with normal appetites and pulses, which I think is a very exceptional performance indeed, and is most encouraging. The Bhotias are certainly some of the finest climbing material in the

world. Unfortunately they are not Buddhists, but very strict Hindus, and are limited by their religious prejudices about diet, which makes them difficult to cater for on the mountain. The question of food for the coolies is very important. Invalid diet is the best way to feed them: a diet suitable for convalescence, nourishing and appetizing.

Mr. Meade illustrated his remarks by pictures taken on his ascent to the saddle of Kamet in 1913.

The Natural History.

Dr. A. F. R. Wollaston, Surgeon and Naturalist to the Expedition.

It would be more easy to talk about the natural history of this expedition after we come back. It would have been much more easy to talk about it earlier in the evening. Prof. Collie has killed all my rats; Col. Bury cut most of the flowers; and Mr. Raeburn dug up the rhubarb; so there does not remain much for me. Both Mr. Raeburn and Col. Bury know the Himalayas very well, so that they are not so excited at the prospect of seeing the flowers as I am. Some of the most stolid of travellers have become quite lyrical in their descriptions of the flowers we are going to see—those fields of all sorts of beautiful things. I think, as a matter of fact, some of the most interesting natural history observations we shall bring back will be about the members of the expedition themselves—about their minds and bodies: their minds particularly. I have been told when you get above 16,000 feet the temper becomes very short. What it will be like when they have been to 29,000 feet remains to be seen. In a medical capacity I hope I shall have very little to do, so far as the members of the expedition themselves are concerned. They are a very sturdy, tough lot. In the matter of the natives of the country one may be permitted to hope that they may occasionally be in need of my professional assistance. Often it happens in these escapades that a few grains of calomel, a dose of castor-oil, or some quinine, will make you good friends who will provide natural history specimens, or even more welcome things such as mutton and goats. I ought to have begun by saying that the Director and others of the Natural History Museum are taking a great interest in this expedition, and through their help we hope to engage one or two native collectors and skinners from the north of India. The specimens will mostly, I suppose, go to the Natural History Museum, and such plants and seeds as we bring home are going to other people in consideration of subscriptions to the funds of the expedition.

The High Climbing.

Mr. George Finch, Member of the Climbing Party.

Those of us who have been selected by Sir Francis Younghusband to make, under the leadership of Mr. Raeburn, the attempt to climb the highest mountain in the world, do not conceal from ourselves the fact

that we may expect to have to face great difficulties and dangers. I have heard a comparison drawn between this expedition and Polar expeditions. Such a comparison I have not found easy to draw. The Polar expedition is a long drawn-out struggle of several months. On this expedition remarkable difficulties are not likely to be met with below 20,000 feet. The ascent, however, of the remaining 9000 feet to the summit of Everest will, if at all, be carried out in ten days or even less, and it seems to me those days will be replete with concentrated effort and strain such as no other expedition has ever demanded. I do not fear our inability to piece out an ultimate route up the mountain. By possible route I mean a route which is not only climbable, but where we are more or less safe from the danger of snow, ice or rocks falling upon us. The risk of our falling ourselves I hope may be eliminated. The question is whether the conditions will allow us to follow the route selected to the summit. On a mountain of such an enormous scale we shall be able to avoid difficult rock climbing. But I think every one of us will have to call up all he ever knew about snow conditions. These, to my mind, will prove one of our main difficulties. I do not mean we need fear avalanches coming down on us, for no good mountaineer recklessly ventures in their path. The great danger will be that at altitudes such as we hope to reach, we may meet with conditions of snow such as none of us have ever seen, of such a dry and powdery nature that all our previous experience of the angle at which snow may be ascended, still less crossed diagonally, may go for nothing. As to the question of altitude, Mr. Meade actually camped at 23,600. Dr. Kellas and Captain Morshead reached the same place last year without feeling any inconvience. Indeed, Captain Morshead goes so far as to say he could have gone several thousand feet higher. I earnestly hope it may be my good fortune to be one of Captain Morshead's companions in overcoming the 6000 feet still to be made. Dr. Kellas has recently carried out a valuable series of temperature observations at altitudes varying from 15,000 to 22,000 feet. By a process of extrapolation one can calculate from these data that temperatures of $-60°$ F. are quite likely, indeed highly probable, on the summit of Mount Everest. In other words, the cold on this expedition will in all probability be Arctic in its intensity. That in itself may not at first be considered a very serious matter, but it must be borne in mind that at high altitudes which must be attained the rate of evaporation of moisture and the loss of heat from the human body will be far greater than at sea-level. One other question, and one which, as far as I am aware, was first recognized by Mr. Meade, is of great importance, and that is the effect of the exposure of the body to ultraviolet light. At high altitudes there are large quantities of ultraviolet light not kept back by the atmosphere. At low sea-level we are protected. Ultraviolet rays impinging upon the skin literally burn it, and the burning is followed by a feverish condition which hardly seems to me to be conducive to health and well-being.

Mountain Photography.

Captain Noel.

I think that all the people who go out to the mountains can be divided into two classes, the real climbers we have heard talking to-night, and the others. I am only a mountain traveller. My journeys were prompted only by the love of the mountains in order to see and photograph them—to see their grandeur, and to bring back a photographic record. Now the real success of the mountain photographer depends largely upon his equipment. The portability of his instruments is a very important consideration. I myself favour the quarter-plate size camera, because with the modern lenses you can get the same definition as with the large old-fashioned cameras. Another point you have to consider is the provision of various lenses, so that you can get a photograph large or small without altering your view point. The problem in photography of snow mountains is this, that you have very large contrasts of light to cater for: the very bright blue sky, the white snow, and the clouds. You must use a yellow filter, to reduce the ultraviolet light, a slow plate of very great latitude, and give a long exposure. Then you have to use a developer which will give you a slow building up of the image. The last point the mountain photographer must consider is his position. A photograph may show correctly the sky, snow, and foreground, but lack atmosphere. The photographer has to turn the ordinary photograph into something more—a picture—and that is left to his individuality to try and accomplish. But on this point of composition I think you come against the limits of photography. I recognize that photography has its limitations, and in order to do full justice to the beautiful mountains in the Himalayas, and bring back a record of the wonderful colours and scenery, you really need an artist and his palette.

The President.

That brings our interesting discussion to a close. Before I close the meeting altogether I should like, in the first place, to disclaim the credit which has been so very generously given to me as regards the organization. All I have done myself is to crystallize an idea which has been in the minds of both the Alpine Club and this Society for many years past—this great idea of ascending Everest. We have heard a number of men of great experience and expert knowledge this evening, and I think you will have gathered that they are thoroughly aware of the enormous difficulties and dangers which they will have to encounter, but I hope you will see that we are making every possible preparation to discount all we possibly can by forethought, arrangement, and organization beforehand; and I hope you have also gathered that there is in the members of the expedition the grit, courage, and determination upon which success will ultimately depend. I do not altogether share these doubts about their being able to find Everest. I think they will find it

easily enough. Colonel Ryder at the close of our mission to Tibet went up to the north, and both he and Major Rawling described it as rising up by itself, and well away from its neighbours, 9000 feet above anything near it. On the one side was Makalu, about 14 miles off, but Everest stood up clear, and from it they described how lesser mountains gradually came away towards Tingri. I do not think personally they will have much difficulty in finding Everest. I agree with Prof. Collie about the extraordinary intricate nature of the actual approaches to the mountain when they get near to it. That is where the mountain party this year will find their difficulties, and where we depend upon them for making a thorough reconnaissance. You can depend upon these younger men to ascend as far as they can. I know you would all like me to thank Prof. Collie and the members of the expedition for the very interesting account they have given us this evening.

Note on the photograph taken by Dr. Kellas from a point about 16,350 feet near the Kang La.

In 1883 Graham climbed a peak in the neighbourhood of Kabru, from which he had somewhat the same view as that shown in the photograph. He described a snow peak and a rock peak as clearly seen "towering far above the second and more distant range," and "showing over the northern slope of Everest." These may have been two of the cluster of lofty peaks north-west of Everest numbered T 45, T 57, B 782, T 42, and B 783, which have been located by the Survey of India but are not visible in the photograph. On the other hand Graham may have meant that the peaks appeared over the northern ridge connected with Everest, and his peaks may be the two shown in the photograph and lettered A and B.

The snow peak A is perhaps over 25,000 feet, and the splendid rock peak B rising behind the further range may be even higher than A, as it is considerably further off. Through the telescope it appeared as a magnificent wedge of light-coloured rock flecked with snow.

The photograph also shows a snow ridge connecting the south-eastern arête of Mount Everest with Makalu through a great rock peak lying between the two. This peak is not in Burrard's List of Summits, though it is about 25,000 feet and is clearly seen from Sandakphu. An unknown snow peak about 24,000 feet with a peculiar crater facing north-east, is seen on the ridge connecting Makalu with the peak N 53. It seems that the whole eastern face of Mount Everest must drain to the Arun through a glacier passing north of N 53.

From other photographs taken on the summit of a peak of 17,400 feet a considerable prolongation of the nearer range is shown, and the cessation of high peaks immediately north of this seems to indicate that most of the unsurveyed lofty mountains lie north-west and north of Mount Everest. Behind the magnificent rock peak lettered C, north-west of peak

N 53, there appears a prolongation of the Mount Everest ridge running to the range that leads to A, which peak seems to be less than 25 miles north of Mount Everest. It may be that this is the "rounded dome" seen by Sarat Chandra Das from about the Semo La and mistaken for Mount Everest. The black rock peak C is the peak seen by Mr. Freshfield and photographed by Signor Sella from the Chunjerma La, but it seems to be east of Mount Everest and not north-west as they supposed. Immediately to the right of this peak the photographs show a fairly low col in the ridge leading to A (the lowest for a long distance), and beyond the col is a precipitous very lofty ridge which must be connected with the cluster of great peaks north-west of Mount Everest mentioned above. The snowy peaks of moderate elevation to the right of the photograph reproduced appear easy to climb and readily accessible from the north; they cannot be far from Tingri.

Dr. Kellas does not name the valleys. That in the immediate foreground would seem to be one of the eastern affluents of the Tambor, the deep valley in the middle distance the main valley of that river. The gorge of the Arun lies beyond the next range of peaks close under Makalu and N 53. In examining this photograph one must remember that it was taken in December, and that the country between Mount Everest and Tingri through which the Mount Everest expedition must advance will probably not carry so much snow in June or appear so formidable as in this photograph.

SIR RICHARD FRANCIS BURTON

Born 19 *March* 1821.

IT is difficult for me to realize that more than thirty years have passed since the death of my old friend Sir Richard Burton; his powerful personality and aggressive vitality seem but a thing of yesterday. Nature, in fact, had intended for him a much longer span of life; but even his iron constitution was not proof against the hardships of exploratory travel and reckless disregard of his own health. I remember his telling me that when, after parting from Speke, he arrived, wounded, starving, and deserted, at the first depôt which had been provided for the explorers, he found there nothing but a few bottles of spirits of wine for a lamp, and in his desperation he swallowed the whole of the contents of one of them.

He was one of the most learned men I have ever come across. Naturally it was more especially in the Oriental field that he was a sort of living encyclopædia. Here there were few questions to which he could not give more or less of an answer. But anthropology, archæology, even Etruscan inscriptions all alike interested him. It was not only

SIR RICHARD FRANCIS BURTON

From the portrait by LEIGHTON in the National Portrait Gallery, by permission of the Director

Arabic or Persian that he translated with a masterly hand, one of his lesser known works is a translation of the Lusiads of Camoens. The subject, however, upon which he chiefly prided himself and considered that he possessed a special knowledge was the history of the sword; unfortunately the first volume only of the exhaustive work which he planned to write upon it was ever completed. As regards languages, Burton combined linguistic facility with philological knowledge, a combination which is by no means common. In setting to work to learn a new language, he once told me, he began with "the swear-words; after that everything was easy."

For the geographer his chief claim to fame rests upon his Somali journey in 1854, when he was the first white man to enter Harar, and more particularly on his explorations and discoveries in Central Africa. But to the world in general he is best known by his pilgrimage to Mecca in 1853, in the disguise of an Indian Pathan. He was the first Englishman to enter the holy city of the Mohammedans, and the first European who has gone there with a thorough knowledge of Mohammedan history, beliefs, and ceremonies. His account of the Pilgrimage has rightly become a standard work of English literature. It was this pilgrimage that made him, next to Homer, one of Dr. Schliemann's chief heroes, as the doctor once confided to me. Schliemann's own ambition was to rival Burton's feat, and he spent a year at Alexandria with this object in view. Circumstances, however, prevented its accomplishment, and the only result was that Schliemann was able up to the end of his life to repeat the Qoran by heart. Shortly before Burton's death I was able to satisfy one of Schliemann's principal desires and bring the two together. As a *hajji* or pilgrim, Burton was free to travel wherever he chose throughout the Mohammedan world, and we once planned an expedition together along the northern coast of Africa, beginning with Tangier and ending with Alexandria. But at the moment we were both of us occupied with our professional duties, and when the more convenient season arrived it was too late.

Burton probably inherited his restlessness, versatility, and fondness for adventure from his Irish and Highland forefathers. He passed from Oxford to the Indian army, and then into the Consular service, much as he passed from one form of study to another. He was impatient of restraint on the part of those whom he considered inferior in knowledge or experience to himself, and in one instance at all events this had an unfortunate effect. He was removed from the Consulship of Damascus just when his profound acquaintance with the Oriental and the Orient was beginning to bear fruit. 'Unexplored Syria,' which he wrote in combination with Tyrwhitt Drake, shows what he might have accomplished had he remained longer at his Syrian post. For once in a way a Consulship could have been made subservient to the advancement of scientific discovery and research.

A. H. Sayce.

AN IMPORTANT ATLAS IN THE BRITISH MUSEUM

E. C. Abendanon

AMONG the valuable and perhaps not enough known atlases of the British Museum there is one that deserves our special attention. It is catalogued under No. 1513 Bibl. Egerton. On the first page of the fine modern binding of this atlas one reads: "The title written in ink on the original parchment binding, was, as far as could be read, 'Livre de la marine de * Pilote Pasterot,† l'an 1587. F.M.'" As a fact the title is most indistinct, especially as to the name, but the 8 of the number (year?) cannot be misinterpreted.

Harrisse twice quoted this atlas. In 1892 ('The Discovery of North America'; London and Paris, 1892) he wrote about it:

"A Portolano, of seventy-eight charts of the coasts of both hemispheres, drawn on a plane scale; with pen-and-ink drawings of cities, fortifications, native inhabitants, animals, and vegetation. The original pencil outlines are visible under the ink. At the end of the volume are original letters of Charles IX of France, exempting Nicolas du Tour, Sieur de Couldray, from the billet of soldiers; dat. Rouen, 16 Aug. 1563."

Then again, in 1900 ('Découverte et Evolution cartographique de Terre-Neuve et des pays circonvoisins,' p. 263; London and Paris, 1900), he mentions it:

"Quatre années s'écoulent et, en 1587, un pilote appelé Pastoret, d'ailleurs complètement inconnu, construit un bel atlas de soixante-dix-huit cartes, en France, mais sans qu'on puisse dire dans quelle ville."

To these descriptions (and others have not come to our knowledge) we may add the following particulars. All the maps of this atlas distinctly want a finishing touch. There are many duplicates and triplicates, but only one of two or three identical representations of coasts has been supplied with geographical names. All maps contain the indications of north and south latitude in degrees. Moreover, all maps are divided by two sets of quadrangles, one standing upright, the other at an angle of 45°. A circle has been drawn round all of them. The seas of these maps are especially livened by very finely drawn sailing vessels, sometimes by monsters of the sea. On the land we see mostly trees, tents, castles, or houses, and more seldom human beings or animals.

In all these respects the maps of this French atlas differ from the well-known Desceliers and Desliens maps of the Dieppe cartographic school. But as we have learned to consider the Dieppe maps, especially for the cartography of the East Indian archipelago, as the missing milestones ‡ in the historical development of its early cartography, so our

* Ought to be *du*.

† In the catalogue itself the name is written "Pastoret."

‡ "Missing links in the development of the ancient Portuguese cartography of the Netherlands East Indian archipelago," the *Geographical Journal*, 1919, p. 347.

thought was that a comparison of the atlas attributed to Pastoret and the world-maps of Desceliers and Desliens might teach us, if not the year of that atlas, at least the state of the cartographical knowledge represented by it. These mappemondes are the Harleian (1536?), the Desliens map of 1541, and the Desceliers maps of 1546 and 1550.

For this comparison it is not necessary to look at the coast-lines of Africa, but we have to study those of the afore-mentioned archipelago, the south part of the Indian Ocean, and the coasts of North and South America.

Folio 4 of the Egerton 1513 atlas, as we will call it henceforth, contains a "partie delaterre de linde occidentalle" in a very old-fashioned way, namely one of the end of the fifteenth century. "Isle Zipango" (= Japan), "Isle St. Lazare," "Ziloly vel silloly" (= Halmahera, much too big), "Timor," and "aubenon" (= Ambon), all put too near to one another, form a mixture of cartographical fantasy after data which had their origin in the times shortly before and shortly after the arrival of the first Europeans in the East Indian archipelago. One may presume that this map was meant by its constructor to be considered as a piece only of historical value in his time.

Folio 55 contains the map of the East Indian archipelago without a title.

The north coast of Java, which island is connected with the large imaginary South land, is almost the same as on the Harleian (1536?). In the eastern part occur two deep south-extended bays, separating a north-south peninsula with the name of "Simbana" (Eg. 1513), or "Symbana" (Harleian), and a long north-south island with "C: dafrelles" (Eg. 1513), or "C. de flones" (Harl.). East therefrom we see "entree de solœc" or "Lentree de soLoç," and still more eastward a triangle-shaped "Tmor" or "Timoros." A series of small islands leads on both maps to the island * of "Seillam" or "Seillan," and a second series of small islands, a little more to the north than the first, leads westward back to the island of "Amadura" (Eg. 1513 and Harl.). The conception of the island of Halmahera on both maps is very much the same, and so it is for the first embryonic representation of Celebes. The differences belong, firstly, to the north-west coast-line of the latter island, which is not shown on Eg. 1513, and is given, approximately, on the Harleian; and secondly, the name of "celebis" (Eg. 1513) or "C: des Sselebres" (Harl.).

North of Celebes is drawn a large west-east island, with the name of "mandano" (Eg. 1513, no east coast) or "mindearao" (Harl., hypothetical east coast). North of this island of Mindanao, three others are drawn near to one another and stretching nearly south-north (Eg. 1513, without north coasts; Harl., with hypothetical north coasts). To the west of these three islands stretches the south-eastern coast of

* East of this island both maps give blanks.

"palabecara" (Eg. 1513), viz. the island of Pelawan; the same island with roughly outlined south-western, north-western, and north-eastern coasts on the Harleian mappemonde.

South of this island of Pelawan, Eg. 1513 contains the whole island of Borneo (without name) with the name of "port de bormio" and "mont S: pol" in the north part. The Harleian map contains only the north-west coast of Borneo (the well-known Spanish discovery of 1521 of the famous Magalhães expedition), whereas the north-east, south-east, and south-west coasts are merely roughly outlined. This difference in the large island of Borneo is most peculiar, for it forms the only real cartographic advance in the archipelago of Eg. 1513 on the Harleian. As a fact, the draughtsman of Eg. 1513 refrained from drawing coast-lines where they were not known,* whereas the draughtsman of the Harleian (Pierre Desceliers) evidently wanted an island to be drawn as an island.

If we now turn to the Desliens mappemonde of 1541, we immediately remark many cartographic amendments. Flores and "timor" have become east-west islands. Halmahera has slightly but distinctly improved; so has "midartaõ" (= Mindanao), and have the three islands north of it. Pelawan has no more than its south-east coast. But "borne" (= Borneo) and Celebes (without its name) show great cartographic improvements.

The Desceliers mappemonde of 1546 equals, in its cartography of the East Indian archipelago, that of Desliens in nearly every respect. But of Pelawan, once more, as in 1536 (?) on the Harleian, Desceliers gives the imaginative south-west, north-west, and north-east coasts. It is clear that, in the cartography of the East Indian archipelago, the Eg. 1513 atlas represents the cartographical knowledge from slightly after 1536, but before 1541.

We have still to mention fol. 56 of Eg. 1513, containing the north part of the archipelago and the sea north of it to the south of Japan. It represents the same piece of coast-line for the island of Celebes with the name "celebis" or perhaps "celebre." Fol. 61 of the Indian Ocean stretches eastward to the west coast of the "Isle de bornio." North of the Philippines the ocean remains open on the maps of 1536 (?) and 1541, but is bounded by a concave-shaped coast on Eg. 1513, wherein we see a little island "Zapinga" (= Japan).

Turning to North America, we have on fol. 8 of Eg. 1513 a map of the "Terre dv Laboratọr." The coast-line closely resembles that on Desliens' map of 1541, but differs in many respects from the Desceliers' maps of 1536 (?) and 1546, which are nearly alike. At the latitude of 45° north, Eg. 1513 reads: "La grand baye. oupassa le capp: Jacq. caretier, Euuoye par le Roy francois premie. por descouurir canada."

The north coast of N. America further on is nearly the same on the

* Except as regards the imaginary South continent.

one Desliens and the three Desceliers maps, but slightly different on Eg. 1513. As for the coast-lines round the Gulf of Mexico, Eg. 1513 and Desliens (1541) go together and are different from the three Desceliers, which are much alike. On fol. 24 there is written west of the peninsula of Florida: "Baye de Jehan ponce." *

As for the north part of the west coast of S. America, there is again a pronounced resemblance between Eg. 1513 and the Desliens (1541) on one side and between the three Desceliers on the other side. The difference between these two ways of drawing that part of the coast is remarkable. It seems thus that for the whole of Central America there is a distinct affinity between the Eg. 1513 and the Desliens map of 1541.

Fol. 12 represents the north coast of S. America up to the "Isle de la trinite" and the "Grande riuiere des Amazones," then it turns first to the south-east and then only to the east. This is the coast-line of the "Terre des caniballes." Desceliers 1536 (?) gives "La trinite," but no mouth of Amazone river; the coast of "Caniballes" runs directly to the east. So Desliens draws in 1541 this same coast east of the Amazon river. Even in 1546, Desceliers does not give much of this river and leaves the coast east from its mouth running to the east. Only on his map of 1550 does he clearly draw the Amazon river, and east of it the coast-line first runs to the south-east, then east, as in Eg. 1513. It is most remarkable that on this map of 1550 by Desceliers, the uninterrupted coast-line has been retouched and taken away so far as to allow the Amazon to flow out freely into the sea.

For this part it would thus seem that the draughtsman of Eg. 1513 had cartographic information of about 1550. But he might also have been better informed on that part of the S. American coasts than Desliens and Desceliers. For in general the coast-line of the south-east part of S. America again is nearly the same on the Harleian of 1536 (?) as on Eg. 1513, both showing a square enlargement of the continent towards the east that is absent from the Desliens' map of 1541 and the Desceliers' maps of 1546 and 1550. Evidently for this coast too the cartographic knowledge improved just before 1541. About the La Plata river we can mention that "Les rivieres de Prata" on the Harleian 1536 (?) are not so well drawn as the "Riviere de Plate," "Riuiere el paranna," and "Riuiere elle paragner" on Eg. 1513, which in this respect is nearly like the "R. de Plate" of Desliens (1541) and the "riuiere de plate" of Desceliers in 1546 and 1550, the latter containing again the names "parana" and "paragan."

The east coast of Brazil on Eg. 1513 being thus almost the same as on

* This name is most probably that of the well-known French navigator and explorer of the coasts of America, called Jean Alfonse. In the years 1543–44 he wrote a book on Cosmography, and the writing is quite different from that in the Eg. 1513 atlas. It is therefore not probable that he was the maker of that atlas; besides, he would not have written his name badly.

the Desceliers of 1536 (?) and not so good as on the maps of 1541, 1546, and 1550, and the La Plata river being better than on the map of 1536 (?) and nearly equal to that on the three last-mentioned maps, it is once more quite clear that the cartographical knowledge represented by the Eg. 1513 atlas dates from between 1536 (?) and 1541.

There is another very remarkable feature in the Eg. 1513 atlas, namely the very developed coast-line of the imaginary Southern continent. Many names of rivers, bays, and capes are given; on fol. 36 we see the "Terre australle" with two sailing-vessels which fly white-red-black flags, "Nauires descouurans les terres." Now the Harleian mappemonde (1536?) has no Southern continent, but it is represented on the Desliens map of 1541 and the Desceliers maps of 1546 and 1550. It gives one the impression that the draughtsman of the Eg. 1513 atlas was the inventor of the South continent, and that Desliens and Desceliers hesitated to follow him in his cartographic imagination, although on the other hand they did not dare to neglect that famous and much spoken-of South continent. Here again the Eg. 1513 atlas dates itself between 1536 (?) and 1541.

Another fantasy, equal on all the maps in question is "Zanzibar: ysle des Geantz" (Desceliers 1536?) = "isle de zanzibar peuplee de geans" (Eg. 1513) = "Isle des geantz" (Desliens 1541) = "Y: des geantz:" (Desceliers 1546) = "Zauzibar" (Desceliers 1550).

To finish our comparative study, let us mention that of Madagascar there is not much to say. Its representation on the map of 1536 (?) is more primitive than that of the Eg. 1513 atlas, and this differs but slightly from that on the maps of 1541 (Desliens) and 1546 (Desceliers).

We must come to the conclusion that the cartographic knowledge represented by this French monument of map-drawing now preserved in the British Museum dates between 1536 (?) and 1541. Most probably the atlas was made in that time too, let us say about 1540. The maps show more affinity to the Desliens map than to those of Desceliers.

As to the clever cartographer himself we venture two suggestions.

Harrisse ('The Discovery of N. America,' 1892, pp. 622–623), writes about the map of Clamorgan as follows:

> "Map of the world made by Jean de Clamorgan, 'seigneur de Soane, premier capitaine de la Marine du Ponent,' and presented to Francis I.
>
> "'Ce grand Roy François qui receut de bon œil quelque chose du peu de scauoir qui est en moy, alors que ie luy presentay une carte uniuerselle en forme de liure, sus un poinct non accoustumé de la figure en plan du monde, où estoyent les mers et terres assises en longitude et latitude, car par une seule face ne se peut demonstrer ne faire sans grandes fautes. Et commanda mondit liure estre mis en sa librairie de Fontaine-bleau.'
>
> "It follows from this that it was a plane chart, with a new style of projection, crossed with longitudes and latitudes, and forming a sort of atlas. As to the date: 'circa 1536,' it is merely approximate on our part. Clamorgan must have been already in the French navy in 1529, as the

last prince whom he served was Charles IX., to whom he dedicated the *Chasse du Loup*, where mention is made of his having occupied an important naval post for forty-five years : ' L'espace de quarante cinq ans qu'ay exercé l'estat et charge de la marine.' The map was presented to Francis I., who died only March 31, 1547 ; but, as Clamorgan spoke therein of Canada as a recent discovery : 'car voyant le beau commencement que continuez de descouurir la nouvelle terre Françoise, Canada, Ochelaga et la Sagueue (Saguenay), sera baillé moyen plus aisé à tous de faire ladite nauigacion,' we infer that Clamorgan's map must have been constructed very soon after the first voyages of Jacques Cartier.

"Although the greatest part of the Fontainebleau library has been preserved, and Clamorgan's map still figures in the inventory of 1682 (No. 6815), that monument of the early French cartography has disappeared. Another work of his, viz. *Traité sur la construction des navires et sur les navigations lointaines*, which may have contained some notice of the voyages of Verrazano and Cartier, is also lost."

There are several facts which seem to make it possible that the Eg. 1513 atlas is the lost atlas of Fontainebleau. The name of Clamorgan however is quite different from that of Pastoret, albeit that this name is very indistinct and difficult to read.

Anyhow, there is reason for another suggestion. According to Harrisse ('Découverte . . . de Terre-Neuve,' 1900, p. 173), Jacques Cartier left France on 23 May 1541, for his third expedition to N. America. Before he came back himself, he sent back Macé Jalobert and Etienne Noël, who arrived at St. Malo before the end of 1541. This name of Jalobert could certainly be read instead of that of Pastoret, and it would seem quite possible that this lieutenant of Cartier, who mentioned the name of his chief on the map of fol. 8, was the artist at St. Malo who, about 1540, made the famous atlas attributed to the unknown Pastoret.

MESOPOTAMIA AND THE WAR—REVIEW

My Campaign in Mesopotamia.— Major-General Sir C. V. F. Townshend, K.C.B., D.S.O. London : Thornton Butterworth, Ltd. 1920. 28*s. net.*

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Mesopotamia as a Country for Future Development.— A. B. Buckley. Cairo: Government Press. 1919. *Price P.T.* 5.

A Dweller in Mesopotamia.— Donald Maxwell. London: John Lane. 1921. 25*s. net.*

THE question of our future policy in Mesopotamia can hardly be decided without reference to the events which occurred there during the war, and it would be well if some of those who advocate the abandonment of the country would study the more important of these volumes. They would then learn, among many other things, what strong motives of policy prompted the early occupation of Baghdad, and how those motives triumphed, at a time when military strategy should have been the guiding consideration, over the reasoned opinion of the practical soldier. They would be reminded of the enormous cost of that triumph and of the increased importance, after the first failure, of securing the political objective; and they would perhaps pause before they took upon themselves to advocate the treatment of a problem essentially imperial from a wholly local and temporary standpoint. Despite some centuries of intercourse, despite the knowledge of Western power and resource gained in the recent war, the traditional Easterner has not lost his traditional exclusiveness, and of all things most certain he still retains his Eastern mentality. In his view the conqueror remains because he is conqueror, and recedes only when and because he is conquered. Regarding Islam as one and indivisible, we may say, "What Baghdad thinks to-day Mohammedan India and Egypt will think to-morrow." Nor need any advocate of economy imagine that this is perverted epigram. If Turkey is no longer to be reckoned as a competitor for the allegiance of England's Mohammedan subjects, English influence in Baghdad must be maintained.

The miniature library of Mesopotamian fact and fiction which the great war has brought temporarily into your reviewer's hands can be divided, as were the Mesopotamian campaigns, into two groups. The dividing line is, of course, the fall of Kut el Amara on 29 April 1916. The first two and by far the best of these books deal with the first period, and the one from which the public will gain the most knowledge both of the earlier campaign and of the general atmosphere of the country is Major Sandes' 'In Kut and Captivity.' Heavy in style and perhaps overfull of detail, it yet towers above all the rest by reason of its obvious honesty and the consuming interest of its subject. It acts as a human corrective to General Townshend's technical apology, and when the battle is over and done the author remembers the wounded and the stricken and traces their various wanderings, most of them, alas! to the bitter end, but some of them more happily to final liberation. General Townshend's book is a record of military decisions and plans carefully noted down at the time with a view to future publication. As a military text-book it will rank high, and it will appeal to students of military science more than to casual readers. To the lay intelligence his exposition of Napoleonic principles will appear unduly laboured, and the magic expressions "minimum force" and "principal mass" become tedious when repeated *ad infinitum.* General Townshend's battles were well planned; his organization was such as to make the first preparations of the Indian Government seem fantastically inadequate; his objections to the advance on Ctesiphon are clearly proved; and his defence of Kut was maintained skilfully and successfully until the latest possible moment. But General Townshend's claim to have brought about peace with Turkey may be dismissed as the soaring of a mind suddenly freed from the strain of captivity. The Turks did not approach him until the game was up, and clearly they hoped by

treating him so much better than his compatriots in their hands to convert him to their point of view, in the mistaken belief that his representations of their good intentions would carry weight with the British Government.

In following the fortunes or misfortunes of the prisoners of Kut Major Sandes has a lamentable tale to tell. By comparison with that of the other ranks the lot of the officers was tolerable, if at times hard to bear. The fate of the wretched men was callous and cruel, almost beyond description. Their treatment was that of slaves, and three-fourths of them perished. How they were left in thousands by the wayside and in hospitals from which the simplest elements of humanity and medical science were absent is, or should be, now well known. No one, however, will find his time ill spent in refreshing his memory and his knowledge from Major Sandes' book. A noteworthy fact is that, according to Major Sandes, such small consideration as these unfortunate men received was due to German officers. Their ill treatment came from the Turk, and Enver Pasha, who was on the scene when the march of death was taking place, is the person in authority chiefly to blame. General Melliss, who travelled in the rear of the straggling procession, was able, by distributing money and sometimes medical aid, to contribute something towards the relief of these hapless sufferers. As between Turk and German General Townshend does not agree with Major Sandes, but his opportunities of judging, having regard to his speedy progress to Constantinople, were not so good.

The history of the second phase is less fully written. Its hero was General Maude, whose untimely death deprived him of the opportunity to write and others of the opportunity to read a first-hand account of his remarkable campaign. Brilliant as were his victories, eclipsing the finest achievements of the earlier phase, it is to be observed in fairness to General Townshend that the successes and failures of the first campaign were recent experience from which he could draw, and they must have been of material assistance to him in achieving his results. Mr. Kermit Roosevelt, Colonel Leland, and Colonel Tennant all write of the second period. Mr. Roosevelt writes as a free lance in an amusing strain. He was a captain in the motor machine-gun corps, and his book is a record of experiences, chiefly his own, and is replete with anecdote and incident. The descriptions are good, and the reader will gather a very comprehensive view of the conditions of campaigning in the country. Colonel Leland sticks rigidly to his title, and, unlike Mr. Roosevelt and Colonel Tennant, writes with a sense of responsibility. His book should be of use to any M.T. officer who is preparing for the next war. On one occasion, when ordered to supply a column in Persia nearly 300 miles from its base, he discovered that the full carrying capacity of each vehicle was exactly exhausted after loading the fuel necessary for the journey there and back. The reader may be left to discover for himself how Colonel Leland solved the problem. Colonel Tennant regards his title as of quite secondary consideration. The author followed General Maude almost as a member of his staff, and regards the Air Force very much from the point of view of any other staff officer. Throughout the book, which is very readable and suggests the style of an accomplished Press correspondent, the Air Force takes quite a secondary place, and the chief value of the book is to give the reader an idea of General Maude and a picture of the country and the campaign.

Of the remaining works little need be said. Mr. Maxwell was an official artist with the Mesopotamian force, and his book contains many charming sketches in colour, monochrome and line, as well as some admirable descriptions of the country. A pleasanter memento of the campaign cannot be

imagined. Mr. Vowles has produced a useful little handbook of the country, amply illustrated with photographs, as are all the books except General Townshend's. Mr. Buckley's pamphlet is an official collection of maps, with some valuable notes on irrigation and agriculture. Mr. Parfit is apparently a missionary who knew the country before the war. His record of progress since the British occupation, if even half true, justifies our remaining in the country. His political views will, however, find little support, and when he attempts to record military events, few, if any, of which he witnessed, he makes the mistake of writing upon a subject of which he lacks adequate knowledge.

In conclusion, it seems worth while to repeat that the political reasons for the occupation of Baghdad in 1915 are not less potent to-day, and to hazard the conclusion that if they were strong enough then to warrant the sacrifice of the sixth Indian Division, they are strong enough now to justify the additional expenditure necessary to maintain British influence in the country. Nor can it be doubted that Mesopotamia is capable of nearly as rapid development as Egypt, and that its potential resources of raw material are far greater.

E. H. K.

REVIEWS

EUROPE

The Place-names of Northumberland and Durham.— Allen Mawer. Cambridge University Press. 1920. 20*s. net.*

THE bulk of this work (Part I.) consists of a glossary of place-names, for each of which the sources are given and explanatory notes added. Part II. gives elements found as the second part of place-names, or used by themselves, and Part III. personal names found as the first element in place-names. Finally there is a short section devoted to phonology.

The author's general exposition of his subject is limited to a brief introduction in which he deals with : (1) The names of the counties and their divisions : here it is remarkable that no trace is to be found of the word "Bernicia," the ancient kingdom which covered practically the whole area in question. (2) The Celtic, English, Scandinavian, and French elements in the place-names of Northumberland and Durham. The prevalence of the Celtic element is very much as elsewhere in England : the river-names are uniformly Celtic, and many names of towns, villages, and farms also. The author infers from the absence of any increase of Celtic names in the west and north-west borders that the Anglian conquest was complete. This inference is supported by the fact that the vast majority of the place-names are of Anglian origin. His conclusions regarding the Scandinavian element do not give much support to the not uncommon belief that the population of Northumberland has a strong Scandinavian strain. "Northumberland and Durham are not counties," says Mr. Mawer, "in which the evidence for Scandinavian settlement is strong. . . . The general distribution of these names compels us to believe that such Scandinavian settlements as there may have been were made by men arriving either from the sea and moving up the great river valleys, or to some extent at least by men moving up from more southerly and more distinctively Scandinavian districts. There is no evidence which could support the idea of an influx from the west, either from Cumberland or from south-west Scotland—Dumfries and Galloway. Further, there may have been very extensive ravagings of the two counties by Viking invaders, but there was,

on the other hand, no definite and permanent parcelling out of the land of these two counties among alien settlers who had ousted the old Anglian population from their farms."

The smallness of the French element would appear to indicate that the direct effect of the Norman Conquest was not great. It is seen in the names of manors to which the holder's name was added, as, for example, in Seaton Delaval.

There is a full and very valuable bibliography. The long and laborious study the author has given to his subject must put under obligation every student of place-names. The general reader will only regret that he did not extend his interesting introduction further and illustrate his researches with a map.

E. A. P.

Records of a Scotswoman. Katharine Stuart Macqueen: a Memoir and Account of her Work.— Olive Maclehose. Glasgow: Maclehose, Jackson & Co. 1920. *7s. 6d. net.*

The chief interest of this book to readers of the *Journal* is that it contains accounts of two journeys to the Balkans, one made in 1912–13 under the Macedonian Relief Committee, and the other, also on relief work, to Albania, in the spring of 1914. The letters and diary describing these two journeys show Miss Macqueen to have been a practical and efficient woman, with a full realization of the dangers inherent in a policy of distributing doles and leaving the cause of the need for these untouched, and the Albanian journey especially, which she herself regarded as a tragic failure, throws much light both upon the difficulties of helping the Balkan peoples and upon their problems. It is curious to note that after her return from Albania in May, 1914, Miss Macqueen proposed to go back with the idea of starting some form of model commercial undertaking in Serbia or Albania. During her visits also all her efforts were directed towards aiding the people in developing the natural resources of their country. In Macedonia she found the Christian women far more energetic and hard-working than the Turkish community, and not unwilling to respond to her attempts to make them independent. The conditions in Albania, on the other hand, struck her as singularly hopeless, and there is not a little to be learnt from her pages about the short-lived principality. The accounts given of the futile but well-meaning attempts of the "Queen" to do her duty and carry out her part are full of humour, and the people, no less than their nominal rulers, continually suggested a combination of 'Ruritania' and 'Alice in Wonderland.'

Even the distribution of alms in the villages was not without its difficulties, on account of the tendency of those whose names had been omitted from the mayor's list of necessitous persons to depose that functionary and fight the favoured parties for the plunder.

In regard to "atrocities" there is a saying so pregnant with wisdom as to merit quotation in full. Speaking of accounts of Turks in Macedonia being shut up in mosques and burnt to death, Miss Macqueen says, "Curiously, the description of what happened tallied almost exactly with one I had heard of a church in a village in Ross-shire where three or four centuries ago the Frasers came down and burnt the Mackenzies, playing the bagpipes round the church as they blazed! If we are to understand these people we have to think ourselves back several centuries."

M. I. N.

The Danube: its Historical, Political, and Economic Importance.— Dr. Henry Hajnel. The Hague: M. Nijhoff. 1920. Pp. 167. *Price* 6*s*.

The title of Dr. Hajnel's book is rather misleading, for it is practically confined to the subject of international law—with special reference to the Danube. The first part of the book (pp. 1–53) discusses general international trade and international law, general river navigation, and the general effects of the Vienna Congress, and then devotes fifty pages to the Danube. The second part professes to deal with the "Danube as Waterway," and does give some details about actual voyages, etc., on the river—before and after the introduction of steam-power. The last chapter even contains some interesting statistics about the Danube tonnage at various intervals between 1856 and 1913, *e.g.* figures which show the rapid increase in Bulgarian tonnage from under 400,000 tons in 1908 to over 600,000 in 1912. On the whole, however, the book is entirely lacking in geographical interest.

The historical and legal merits of the book are great, and it is all the more acceptable because free from the quibbles and lack of common sense which have marred the works of several other Dutch writers in recent years. For instance, on p. 7 Dr. Hajnel almost implies that he agrees with the Vienna Congress in accepting as international any "navigable rivers which either separate two states or flow through two or more states"; and later (p. 48) he draws attention to the incompleteness of Klüber's 'Acten des Wiener Congresses,' from which most writers on the question borrow so largely. His attitude to "the Feudalists" (p. 8) is most welcome, as is the inference from his discussion of the Ferrara Pact of 1177 A.D. (p. 9) that the first treaty about International Rivers was essentially geographical, not legal, *i.e.* that "International Rivers" is *not* "a notion which belongs purely to International Law." Similarly, on p. 25, he ungrudgingly allows to France, through the Revolution, full credit for making "a landmark in the history of the navigation of rivers." The book is admirably printed, but one bad misprint has crept into p. 108, where Trajan's victories in Dacia are dated "107 *B.C.*"

L. W. L.

The Turks in Europe: A Sketch-study.— W. E. D. Allen. With a preface by **Brig.-Gen. H. Conyers Surtees, C.M.G., D.S.O.** London: John Murray. 1919. 10*s*. 6*d*. *net*.

The book, described as a "chronicle of man's savageness and meanness," s divided into four chapters, dealing respectively with the periods 1288–1566, 1566–1792, 1792–1871, and 1875–1914. But the first two chapters are short, and by far the greatest amount of space is given to the modern period, that which has been most fully discussed by recent authors. There is no list of authorities, and the comparatively small number of footnote references are mostly to recent books, and even so are in several cases scarcely full enough to make access to these easy. There are two useful coloured maps, and a good index, as well as a Chronological Table of the chief events in Ottoman History.

The book forms a useful short summary of Turkish history, though from our point of view it would have been improved by some consideration of the effect of geographical conditions on history. Its author also makes no attempt to adopt the historian's detached attitude towards all forms of human activity; the villain of the piece is only secondarily the Turk and primarily "Man, not wicked but stupid, always stupid!" "Intolerance, savagery, callousness, exploitation, down through all the centuries to the twentieth century!"

M. I. N.

Der Salpausselkä.— **Von I. Leiviskä.** Mit 148 Abbildungen, 434 Profilen und xxvii. + 2 Karten. Helsinki [Helsingfors]. 1920. Pp. viii. + 388.

The Salpausselkä, outer and inner, are two lines of elevation in Finland, the former starting in the Hangö peninsula, and the latter in the Bromarf district, which is almost an island, being connected with the mainland by a narrow neck. The two ranges run parallel to one another throughout their course, at first in a north-easterly direction, and afterwards in great curves gradually turning from east to north-east and north. They present an interesting problem in glacial geology, which Dr. Leiviskä has studied with great care and thoroughness. With the help of his pupils he has examined the ranges and their structure in all parts, and in these pages records the results of his labours, illustrated by a map of the whole system, many sketch-maps of important sections, and very numerous photographs and profiles.

The forms are of great variety, broad-backed and flat-topped ridges being the most common, while plateaus are extremely characteristic of both Salpausselkä. Sometimes the range consists of two or more parallel ridges, sometimes it breaks up into hills and dales, and occasionally there are complete breaches of continuity. The ridges are of various heights, from a few dozen yards to 300 or 400 feet and more. With them are associated numerous åsar, especially between the ranges and within the inner Salpausselkä. Two main directions are noticeable, one parallel to the glacial striæ and at right angles to the range itself, and the other transverse to the direction of the movement of the inland ice. The material of which the ridges are composed is morainic débris and the fluvio-glacial deposits of the åsar are piled up on a structure of solid rock, which in some places rises up above these deposits.

It has for a long time been stated in geological literature that the Salpausselkä are marginal formations of the inland ice, and that they were built up during a prolonged period of rest on the retreat of the ice. Their origin, however, has not been treated as an independent problem, but has been explained by preconceived theories of the formation of åsar, the subglacial tunnel theory and the delta theory. It would take too long to set forth the arguments derived from his close observations by which Dr. Leiviskä shows that the Salpausselkä cannot have been built up by subglacial ground streams. His theory is that the material, or at least the greater part of it, has been transported in the ice, and when the ice thawed has been deposited or carried a short distance further by the water from the melted ice. Nor can the plateaus, which often extend unbroken for several miles, have been piled up by separate streams; in general they mark the upper limit to which effective action of the sea has reached.

Whatever climatic conditions prevailed when these accumulations were piled up, Dr. Leiviskä holds that they would not by themselves account for the long halt in the retreat of the ice. The varying heights of the uppermost terraces of the Salpausselkä indicate that the land was rising when these ridges were formed, and, as is well known, the upheaval was greater towards the north-west, so that at this period the rocky skeleton of the Salpausselkä was the boundary between the ascending slope from the basins of the Gulf of Finland and Ladoga and the almost horizontal plateau of the hinterland, and moreover between the sea and land, or, more precisely, between the deep and shallow water. From this configuration and the different character of the country on which the margin of the ice rested when it had retreated as far as the Salpausselkä Dr. Leiviskä infers that the ice must have made a long halt even if the climate remained unchanged. W. A. T.

AFRICA

Das Abflusslose Rumpfschollenland im Nordöstlichen Deutsch-Ostafrika.—Dr. Erich Obst. Teil I. (Mitteil. Geogr. Gesellschaft in Hamburg, Band XXIX.) Hamburg: L. Friederichsen & Co. 1915. *Price not stated.*

This work, issued from the press at Hamburg over five years ago, after the commencement of the war, has only recently reached England. It should be read in conjunction with earlier books, that of Dr. O. Reche on the Ethnography of the same region (1914), of F. Jaeger on the Highlands of the Giant Craters (1911), and of Bernhard Struck on the languages of the Tatoga and Iraku peoples (1911). In some respect the country covered by these German explorations and the works which describe them so well is to the man of science and even to the man of affairs the most remarkable part of (what was) German East Africa. It seems possible that the Iraku and Ilamba districts are the most richly mineralized parts of Zangia; considerable areas in Umbugwe, Umbulu, and Irangi had already, before the withdrawal of the German power, offered themselves to European colonization (because of their elevation, freedom from germ-diseases, water-supply, and fertile soil), and were studded with factories, mission stations, plantations, and mining centres. Ethnographically these countries lying to the south-west of Kilimanjaro and the north of Ugogo are of the highest interest, as they are also linguistically. Here you have scattered colonies of the Bantu speaking Bantu languages of importance in their relationships; pastoral tribes (Tatoga and allies) of Nandi stock related to the peoples of the Northern Rift Valley, and a much specialized branch of the Nilotic group; the Iraku, Fiomi, Wasi, and perhaps the Mbulunge tribes who are distantly allied to the Hamites in speech and partly so in physique (that is to say, related to the Gala and Somali); and lastly the Sandawi and Kindiga, whose language sabound in clicks and offer a slight resemblance in word-roots to Hottentot, and in phonology to Bushman.

This region, so curiously withdrawn from the other great watersheds of East Africa, sending its rivers neither towards the Indian Ocean nor to Tanganyika, nor to the Nile basin, but using them up in large and small salt lakes, in measureless swamps and vast depressions that were once shallow lakes in times of greater rainfall; of rift valleys and faults; of large, small, and even gigantic craters, the rims of which reach almost to snow-level; of conifer forests; of grassy prairies teeming still with game; of beautifully moulded hills and wooded valleys; of tumultuous rivers that flow for hundreds of miles and then sink into the ground and finish; of hot mineral springs; of phosphate and soda deposits: is deserving of the most minute research. Its dried-up lake-beds are believed to contain deposits of Pleistocene, Pliocene, and Miocene age which may yield evidence of an earlier mammalian fauna, or may elucidate the origin of the existing mammalian types of Africa, together with the evolution of the African forms of man. Here, seemingly, we have the birthplace of the Hottentot race, and perhaps a former home of the Bushmen and Strandloopers. There are traces of the Congo Pygmy embedded in such tribes as the Kindiga, who are living under the most primitive conditions, without agriculture or domestic animals and—until recently—without clothing. On the other hand, some of the finest peoples in physique and appearance still have their dwelling in these valleys and on the pleasant Iraku hills. Herein, so far as we are advised, the Germans governed well and had no troubles with the natives. When nearly all the rest of their East Africa had risen against them in revolt, the peoples of this self-contained watershed remained tranquil and friendly. How far this land of peace and progress suffered from the War we

have yet to learn. It is to be feared that in the conflict between the whites many lost their lives, and that much of the results of white colonization, industry, and research were accidentally destroyed.

It will behove us not only to restore what our predecessors achieved, but to go far beyond them in developing the inherent wealth of this wonderland ; and at the same time to have the utmost regard for the native peoples with whose help we might make this region one of the richest and most productive parts of Africa. It is curious to note, by the by, that in former times, in the days of Zangian overlordship and the slave trade, the Zanzibar Arabs never obtained a footing here, nor did any influence of Islam penetrate ; but that before the German rule came to an end Makua porters and workmen from the south had been making converts to Islam and building mosques.

The book under review and its associated literature ought certainly to be translated into English and put thus at the disposal of possible British immigrants. H. H. JOHNSTON.

The Handbook of Uganda.— **H. R. Wallis, C.M.G.** Pp. xxi. and 316. *Map and Illustrations.* Second edition. Crown Agents for the Colonies, London. 1920. *Price* 7*s*. 6*d*.

This is an official publication of the Uganda Protectorate Government. The author, who was for years Chief Secretary to that Government, deserves high commendation for having given in moderate space a comprehensive account of the Protectorate which is not only "up to date" but is eminently readable. In this edition chapters have been added on geology, botany, the part played by Uganda in the Great War, and on the work of the Christian Missions—to which work the progress of Uganda is mainly due. The present writer has subjected the Handbook to close examination and has rarely failed to find the information sought. It should be consulted by all visitors to and students of Uganda ; residents in the country will scarcely need to be told of its value.

The account of the extension of "home rule" to areas where no dominant ruling tribe was found is particularly interesting. A more complete account of the working of the dual system of government, European and native, in the more advanced provinces, *e.g.* Buganda, would have been welcome ; also a more precise account of the rights of Europeans to acquire land and measures taken to prevent the natives too easily parting with their patrimony. Fuller reference might have been made to the position of the Indian settlers and traders. The population and vital statistics given are by an oversight undated ; they are for the year 1919. In the bibliography the place as well as date of publication should have been cited. These are points worthy attention in the preparation of a third edition. F. R. C.

In Wild Rhodesia.— **Henry Masters** and **Walter E. Masters, M.D., D.D.** Pp. 246. *Sketch-map and Illustrations.* London : Francis Griffiths. 1920. *Price* 6*s*. *net*.

This is an account of North-West Rhodesia, its physical features, flora and fauna, and its inhabitants, none the worse for being given in popular form and with many illustrations. The authors went to Rhodesia in 1905 as missionaries, and they discuss missionary influence and prospects with authority and with marked sanity. The book is also worthy of perusal for the picture it gives of a period that has passed—of pioneer life, travel, and adventure before the

coming of the railway. It is very brightly written, and the chapters on native customs and mentality show not only sympathy with the African, but an understanding too of the white man's difficulties. F. R. C.

AMERICA

The Governor and Company of Adventurers of England trading into Hudson's Bay during two hundred and fifty years, 1670–1920.— Sir William Schooling, K.B.E. London: The Hudson's Bay Company, Hudson's Bay House, Lime Street, E.C. 1920. Pp. 129. *With Illustrations and a Map of Canada showing the establishments of the Company.*

The Committee of the Hudson's Bay Company were fortunate to secure the services of Sir William Schooling as the eulogist of the 250th anniversary of the Company's foundation. He has produced a most readable, well-printed volume, which gives an attractive *résumé* of the Company's history. Unfortunately, the style of the illustrations is unpleasing and unworthy of a serious historical work; some of the reproductions of early documents and drawings are, however, of interest.

In some respects however the eulogy seems overdone. According to Sir William Schooling, "the seeds sown by the enterprise of the servants of the Hudson's Bay Company have led to the development of an ample and abundant life in ways that were never expected" (p. 10). To be sure, the Company from the financial point of view has been remarkably successful. Thus the original capital of £10,500 was increased in 1688 to £31,500, rose in 1720 to £94,500, to be made to £400,000 in 1821, until in 1863 it reached two million sterling. To-day it must be a very much larger sum. This success Sir William Schooling rightly attributes to the business acumen of the London committee; but there were other factors which would also seem to deserve mention.

When the Charter was first granted, no one had the remotest idea either of the tremendous width of North America, or that from the waters emptying into Hudson's Bay the Company's factors would eventually be led to the shores of the Pacific Ocean. Throughout this enormous area the Hudson's Bay Company has benefited more from the "ample and abundant life" of the inhabitants, both white and red, than from that of its own factors. Even Sir William Schooling is forced to admit (p. 80) that in neglecting the north-west coast, from which the Russian-American Fur Company drew in the thirty years previous to 1817 over two and a half million seal-skins, "the Hudson's Bay Company recognized too late the opportunities it had missed by failing to penetrate to the full limits of its chartered domain." Indeed, it has nearly always required the rivalry of a local Canadian competitor to stir the Company into any new enterprise. Thus the North-West Company, which has been called "the most terribly effective organization that has ever arisen in the New World" (p. 31), by its amalgamation with the Hudson's Bay Company in 1821 gave to the latter an energy which it sorely lacked. The same may be said of the more recent expansion of the Hudson's Bay Stores in the North-West. It was only the advent of enterprising Ontario rivals which forced the Hudson's Bay Company to develop this branch of its business.

The Company's servants in Canada have rarely been given any real liberty of action by the London Committee. In certain matters such as the brandy trade, the beginnings of which Sir William lays at the door of the North-West Company, this control has undoubtedly proved beneficial, but in the matter of geographical discovery it has worked to the disadvantage both of the Com-

pany and of Canada. The author gives the Company full credit for every act which helped discovery of which he can find any trace, but when all is said, the record of such a rich corporation in this direction is a poor one.

The truth is that the interests of the Company have lain and still lie in trade. Fortunately for it the demand for beaver has been a steady one. "The substitution of silk for beaver fur in the manufacture of hats in 1839," says Sir William (p. 49), "led to a great fall in the value of the fur, but this has been fully atoned for by its present extensive use for collars, stoles, and muffs." Similarly the busbies of the Hussars have kept up the demand for lynx. In their dealings with the Indians the Company's factors have invariably been fair, and as the author rightly states, "there has never been an Indian war in Rupert's Land" (p. 45). The Company has, of course, invariably looked after its own interests; and in the cession of its territories to Canada in 1869 made a bargain which it has never had cause to regret.

Sir William Schooling brings his book to an end with an interesting account of the Company's transactions on behalf of the French Government which were carried out during the Great War. The Company has hereby added another wonderful page to its striking annals which will always be remarkable for the success which has attended it as a thriving business Corporation.

Jamaica under the Spaniards: abstracted from the Archives of Seville.—Frank Cundall, F.S.A., and **Joseph H. Pietersz.** Kingston, Jamaica. 1919.

The object of this work, to quote from the author's preface, was not so much to write a chapter on the history of Jamaica under the Spaniards, as to give some indication of the information contained in the Archives at Seville relative to this period of Jamaican history. That object has been abundantly attained. The book contains an abstract of a large number of documents—letters from Spanish governors of Jamaica, communications from the Crown to Jamaica, communications from royal officials, etc.—and shows the existence of a mine of material for the early history of Jamaica. It is not to be expected that a summary of a variety of State Papers should make either easy, intelligible, or consecutive reading, but some of the documents have been quoted at length and are of very great interest, as, for example, the account given by the Abbot of Jamaica of the state of the island in 1611, also the various accounts of the capture of the island by the English in 1655, and the subsequent struggle which lasted till 1660. But, valuable as the summary is for the information which it gives, or shows to exist, it might in one respect have been better done. It would have added very little to the length, and a good deal to the utility, of the book if a description in a few words, or short title, had been given to each document. As it is, it is often difficult for the reader to tell the nature of the successive documents which are summarized, or even where one ends and the next begins. However, one must be grateful for so large an addition to our knowledge, not only of Jamaica, but also of the early struggles of colonization and the growth of Spanish colonial policy. Jamaica was never very successfully planted. The Indian population became almost extinct, the Spanish settlers moved on, the towns decayed, the churches fell in ruins. But, none the less, its situation and its productivity marked it out as important. It was "a granary, warehouse, and military station," and its ultimate loss to England was a serious blow to Spanish power. Among the records of Jamaica in the Archives of Seville are eight maps, of which four are reproduced in this book.

E. A. B.

West Patagonien: Die Patagonischen Kordilleren und ihre Randgebiete.—Dr. Hans Steffen. 2 vols. Berlin: D. Reimer. 1919. Pp. 670. *With* 32 *Plates*, 67 *Figures*, *and* 13 *Maps*. *Price* 80 *M.*

The author, formerly professor at Santiago University, has carried out many important expeditions in Patagonia ; he was the first to cross the Andes from the Pacific coast and to thoroughly explore the great river systems of the Yelcho, Puelo, Manso, Cisnes, and Aisen-Baker (or Cochrane), and he has also made other journeys in Southern Patagonia.

These substantial volumes are full of valuable information regarding the geography, geology, and climate of Chile south of 41° lat. There are numerous notes also on plant distribution, on those few aboriginal tribes which still survive, and on the economic prospects of this most interesting region, of which vast areas are still marked, even on the author's excellent maps, as "inexplorado." It is clear also that the literature of Patagonia has been carefully studied ; even the journeys of the Jesuit missionaries in very early times are recorded, and their routes are traced wherever it is possible to do so. Any one, therefore, who wishes to make a thorough study of Patagonia must necessarily consult Dr. Steffen's book. We can here refer to but a few of the many important questions which are discussed by him.

Dr. Steffen appears to admit the usual theory that the whole west coast is a drowned land ; also that the Moraleda channel is probably a continuation of the tectonic depression which is occupied farther north by the central valley of Chile. He continually protests, however, against the view that there is a central chain of the Cordillera and does not either explicitly admit or deny the existence of a similar, longitudinal, north-and-south tectonic depression east of the Andes in which lie the basins of many of the great lakes. This last meridional valley is postulated by Dr. Moreno, and we think by most of those who have discussed the question.

Dr. Steffen shows that the west coast as well as the mass of the Cordillera is dissected by "deep lines." One set of roughly parallel fiords or valleys being intersected by another series nearly at right angles produces a division into "blocks" which are well shown on his maps. An interesting sketch on page 416 brings out this arrangement for the district between 44° and 46° S. lat. Very great depths are found not only in the north-and-south channels such as the Moraleda (137 to 320 metres), but also in those more or less east-to-west sounds which are in continuation of the line of the river valleys (*e.g.* Cay canal 90 metres, Tuamapuka 250 metres). These observations appear to show that some of the greater rivers have submerged channels extending to near the continental shelf. Dr. Steffen believes in the theory of antecedent drainage, and supposes that the larger rivers managed to keep their valleys open during the upheaval of the Andes. But he does admit that the Pacific torrents have in many cases beheaded the Atlantic rivers.

With regard to the eastern tectonic valley, he points out that the basins of many of the lakes once extended over much greater areas than is the case at present. One could hardly, however, expect this valley to be recognizable all the way from Nahuelhuapi to the straits of Magellan, for there are huge districts covered by lava-sheets of two different ages, and there have been two periods (as Dr. Steffen shows) of great glacial activity, with the result that ice-age terraces and morainic matter make the original condition of the ground very difficult to follow. Dr. Steffen states that many of the east-to-west valleys are "trogformig," or trough-shaped in section, which he takes to prove that they have been finally cut out by valley glaciers.

Seeing that both Chile and Argentina have loyally accepted the boundary as drawn out by the commission under Sir Thomas Holdich, we fail to see what object Dr. Steffen has in continually finding fault with that award. The valleys which were then in question were of easy access from the Argentine side. No farmer or settler could possibly bring his goods to some very moderate harbour on the Pacific coast by such tracks as are very well described by Dr. Steffen himself. He himself enlarges on the unmitigated rain, frequent blizzards, rivers full of snags and rapids, carrying uprooted trees, and rising without warning into huge floods. The valley sides are steep, rocky and broken by landslides; the forest is often impenetrable or tied together by the climbing chusquea bamboo ; the valley floor is frequently liquid mud often several metres deep. In such country as this communication with the west coast is economically impossible. Dr. Steffen's attitude towards the work of other, and especially of Argentine, travellers is inclined to be critical. Thus he did not find those continuations of the San Tadeo glacier which are shown on the charts of King and Darwin as extending south to the shore of Kelly fiord. If these existed in the time of the *Beagle* expedition, there must have been a considerable retreat of the ice which one cannot prove in other parts of the San Tadeo glacier. So Dr. Steffen concludes that the sketch is erroneous. But on p. 553 he points out that a glacier in the Benito estuary is *in rapid retreat* and remarks that this is a repetition of the view of the foreland of the San Tadeo glacier! On the whole, then, it is quite likely that Darwin is correct.

The author has much that is interesting to say of the various proposed routes across the Andes. He condemns the road by the Perez Rosales pass and lakes Todos Los Santos and Llanquihue on account of the frequent changes from land to water transport. This is unfortunate, as we had supposed this to be the most promising route for a transcontinental railway ; but perhaps train-ferries might solve the difficulty. Many valuable notes will be found regarding harbours, prospects of fishing, settlement, and other economic questions of the future.

Many of the plates are extremely beautiful, and the printing and general get-up of the book are excellent. G. F. S. E.

AUSTRALASIA AND PACIFIC ISLANDS

The Northern D'Entrecasteaux.— **D. Jenness, M.A.** **(Oxon.)** and the late **Rev. A. Ballantyne,** with a Preface by **R. R. Marett**. Oxford : Clarendon Press. 1920. 12*s*. 6*d*. *net*.

The D'Entrecasteaux Archipelago which flanks the south-eastern extremity of New Guinea is to all intents and purposes a *terra incognita*, and we are therefore thankful to the Oxford Committee for Anthropology for enabling Mr. Jenness to visit that region and collaborate with his brother-in-law, the late Rev. A. Ballantyne, who had already resided on Goodenough for nine years. The result of their joint studies is a small monograph devoted almost exclusively to Goodenough Island. The intimate acquaintance of one of the authors with the people is an additional guarantee for the reliability of the information imparted. The book gives, in an interesting, clear, and concise manner, an admirable picture of savagery that has scarcely yet been thoroughly tamed, the investigations having been made at that ideal stage when past practices are still alive in memory. The geographical aspects are kept well in view, and the excellent chapters on "The Economic Environment" and "The Social Milieu" will be of especial value to anthropogeographers. The social organization and social customs, the life-history of the individual, the ritual of

the garden, and the accounts of the magic and religious ideas of these pleasing cannibals are succinctly described, and fill up a gap in our knowledge of Papuan ethnography, for it is very strange how little has been written about that archipelago. It may be added that much more remains to be investigated; the great Fergusson and Normanby islands still await scientific exploration. The ethnological specialist would be grateful for more detail on many subjects, and he cannot but feel that a good opportunity has been missed for clearing up certain matters of local and wider interest. Greater pains should have been taken to identify various plants and animals, for general terms or native names do not give the requisite precision; for example, a "squirrel" is mentioned several times, but there are no squirrels in Australasia. The index is somewhat inadequate, but the illustrations are numerous and excellent.

A. C. H.

De Reizen van Abel Janszoon Tasman en Franchoys Jacobszoon Visscher ter nadere Ontdekking van het Zuidland in 1642–3 en 1644. Uitgegeven door **R. Posthumus Meyjes.** (Werken uitgeg. door de Linschoten-Vereeniging, XVII.) *Met* 10 *Kaarten en* 68 *Schetskaarten Landverkenning en Platen.* 's-Gravenhage: Martinus Nijhoff. 1919.

Swart's inaccurate reproduction of Tasman's Extract-Journal is now only to be obtained second-hand, and Mr. Heeres' great work (reviewed in the *Geogr. Journ.*, vol. 13, p. 227) is of inconvenient form and owing to its high price is seldom found except in large libraries. Therefore the Linschoten-Vereeniging has issued the more important documents bearing on these voyages, which will thus be within reach of every one.

The editor, Mr. Meyjes, in a long introduction, relates what little is known of the private lives of Tasman and his colleage F. J. Visscher, and gives brief summaries of the services they rendered to the Dutch East India Company. He also refers to older voyages to Australia, showing that before Tasman's voyages the northern coast had been roughly reconnoitred from the Gulf of Carpentaria to the north-west point of Melville Island, about 11° S. lat., and the west and south coasts from lat. 21° S. to Peter Nuyts land. The credit of the first discovery of Australia he yields to the Portuguese, following Major's original belief in the story told by Manoel Godinho de Eredia of discovery of part of the continent (under the name Nuça Antara) in 1601, five years before the *Duyfken* entered the Gulf of Carpentaria. It is somewhat surprising that Mr. Meyjes, usually so well informed, should be unaware that Major, who put forward the idea of a discovery by Eredia in a paper printed in *Archæologia* in 1861 (also issued as a supplement to his 'Early Voyages to Terra Australis'), subsequently not only transferred the credit of first discovery to the French, on the supposed evidence of the maps of the Desceliers school, but completely retracted his belief in Eredia, whose story he showed pretty conclusively to be an entire fabrication (see papers in *Archæologia*, vol. 44, 1873, Part 2). Apart from this retractation any claim to a discovery in the Southland of the land of "Beach," now well known to be merely a printer's error for the Locach of Marco Polo (Siam or Cambodia), is on the face of it open to grave suspicion.

Mr. Meyjes frequently refers to Mr. Heeres' work, but he does not always agree with that writer's opinions; notably with regard to the relative values of the Extract-Journal in the Rijks-Archief and the Huydecoper MS., which Mr. Heeres styles "a slovenly transcript." Mr. Meyjes replies that the copyist of the R. A. Journal should rather be charged with slovenliness, since he sometimes omits whole sentences and thereby alters the meaning in some cases.

Nor does he admit that the maps in the Huydecoper MS. were "pasted into it at some subsequent period." The most important, that of New Zealand, bears a superscription stating that it was drawn by Franchoijs Jacobszoon (Visscher). In most essential details it is identical with that in the Extract-Journal, and Mr. Meyjes believes that the latter is a copy. The map of the Tonga and Fiji islands is also ascribed to Visscher, and it is stated that the names were inserted according to the directions of Tasman. The authenticity of the Extract-Journal is, however, guaranteed by Tasman's signature.

The directors of the Dutch East India Company expressed dissatisfaction with the results of both the voyages of 1642–3 and 1644. Mr. Meyjes concludes that Tasman was a good seaman but a somewhat inefficient explorer. In the "Zee Haens bocht" the current ran so strongly from the south-east that Visscher inserted a strait (Cook's Strait) on his map, and he holds that more persistence on the part of Tasman would have verified its existence. On the second voyage he seems to have made no serious attempt to sail in the direction of Torres Strait, though particularly instructed to ascertain whether New Guinea was attached to the South Land, and he made a very superficial investigation of the north coast, possibly, as has been suggested, through keeping too far off shore. This verdict is perhaps open to question.

In an appendix Mr. Meyjes discusses the latitudes and longitudes, observed no doubt by Visscher. The former he finds wonderfully accurate, while the latter are not "quite hopeless," as they have been styled. Before sextants and chronometers came into use longitudes could not be ascertained with accuracy.

The maps in the Extract-Journal are reproduced in this volume, many on a reduced scale, and to these are added copies on a small scale of part of the map on the floor of the council chamber of the Ministry of War at Amsterdam, and of part of Bleau's globe (*c.* 1648). The former has already been discussed in the *Geogr. Journal*, vol. 56, p. 232. W. A. T.

Captain Bligh's Second Voyage to the South Sea.— Ida Lee (Mrs. Charles Bruce Marriott). London: Longmans, Green & Co. 1920. Pp. 290. *Charts and Illustrations.* 2 *Diagrams.* 10*s.* 6*d. net.*

A much wanted book, for which geographers and naval historians have long been on the look-out. The task of producing it was at last undertaken by Mrs. Marriott, who is no novice at work of this kind, and has acquitted herself excellently well. It is remarkable that Bligh never published any account of this voyage, in which he commanded H.M.S. *Providence*, with the armed tender *Assistant*, and completely redeemed the failure of his previous expedition in the famous *Bounty*. In the present volume all the essential facts of the voyage to Tahiti and the collection there of bread-fruit plants, the continuation to the Fiji Islands and systematic exploration (as far as time permitted) of that group, and the passage westwards through Torres Strait, are clearly related. Copious extracts from Bligh's journal,which is preserved at the Admiralty, and from those kept by some of his officers (now in the Record Office), supplement the narrative, and reveal Bligh's deep interest in his work and the intense care with which he executed it. These journals are full of circumstance and relevant remarks. They make clear once for all that Bligh, ably seconded by Portlock in the *Assistant*, was the real discoverer of the bulk of the Fiji archipelago, outlying parts of which Tasman in 1643, and Cook in 1773, and Bligh himself, when in the *Bounty's* longboat, had seen but did not examine. And they supply interesting details of the first known meetings between Fijian natives and white men.

Mrs. Marriott also exhibits Bligh as the discoverer of the intricate northern channel through Torres Strait. As she observes in the Introduction to this volume, "Bligh had extraordinary opportunities of proving his skill in navigation ; in both voyages he was singularly fortunate, and in both voyages he made fresh discoveries where Tasman and Torres had preceded him." These discoveries were of eminent utility to subsequent navigators, and to the world's commerce in later years ; so that, to quote the authoress again, "it is not too much to say that his countrymen are indebted to him for their first knowledge of Fiji and of the islands in Torres Strait."

Whatever Bligh's personal faults may have been (and his martyrdom to malarial headaches or migraine may well account for some of them), one cannot but believe that the chiefs of the Admiralty, after reading these journals, must have felt entire confidence in his skill and prudence as a navigator, his loyalty and devotion to the duties entrusted to him, and his particular qualifications for successfully treating with the Tahitians. He became deeply interested in those islanders' family affairs, their national politics, their social customs, and religious rites ; but, unfortunately, though he could chat with them in their own language (having twice been at Tahiti before), he had no conception of its orthography ; and, if Mrs. Marriott's book displays a blemish at all, it is due to the outlandish and grotesque spelling of native names and expressions transcribed from Bligh's journal. The book has evidently been prepared with close care and judgment ; there are a few unimportant slips of a typographic kind, and here and there a minor error which only readers familiar with life in the islands will detect. Some of these may represent original mistakes in the MS., which was, mostly, not written down by Bligh's own hand but dictated to his clerk, Edward Hatfull. An example is "weasel" for "weevil," at June 7, page 112. It would have been better to state, in note 2 on page 38, that Tahiti was *annexed* to France in 1880, instead of quoting it as a "Protectorate" from 1842. The book is one that should fill a long-standing void, and remain the authority on the transplantation of the bread-fruit tree from Tahiti to the West Indies and St. Helena.

B. G. C.

MATHEMATICAL AND PHYSICAL GEOGRAPHY

Grundlagen der Photogrammetrie aus Luftfahrzeugen.— Profs. **Hugershoff** and **Cranz.** Stuttgart : Konrad Wittwer. 1919. *Diagrams and Illustrations. Mk.* 23.40.

Profs. Hugershoff and Cranz dismiss as impractical or too costly photography from airships or balloons, and deal only with photography from an aeroplane. Starting with the necessary skeleton of fixed points, they resect the position of the camera in space at the moment of exposure. The co-ordinates (on the negative) of the trig. points referred to are measured on oblique views taken at an angle of depression of about 30°. Additional ruling points are also fixed from these obliques, but much of the detail survey follows by plotting from photographs taken vertically.

An actual survey was made near Dresden with instruments manufactured by Gustav Heyde, and figures, photographs, and completed map given in the text illustrate it. The cameras used (two) took 13 × 18 cm. plates which were respectively at 165 and 280 mm. from the rear principal point of the lens. Sights, spirit-level, and vertical arc were provided, and a "between the lens" shutter giving a minimum exposure of 1/200 second.

The sensitized side of the plate is pressed against a frame in which four small holes are bored. The corresponding small dots on the negative define its

co-ordinate axes. An explanation of how to determine the position of the optical centre and its distance from the rear principal point of the lens follows. Three fixed points on the photograph are sufficient for this calibration, but more are used generally and a mathematical adjustment made. Sample computations are given, followed by an investigation of the errors of distortion due to the object-glass. Measurements on the negative must not show errors of more than 0·02 mm. To reach this refinement a special comparator fitted with microscopes is used. The next section deals with the "Bildmess Theodolit," used for the measurement of horizontal and vertical angles on the negative. The negative is replaced in the same or a similar camera, registered by the dots, lighted, and observed upon through the object-glass, thereby eliminating errors of lens and of interior adjustment of the camera. The first theodolite of this nature was made in 1896 to a design by Herr Koppe.* The instruments made by Gustav Heyde depart from the original in important points, and have been adversely criticized by Prof. Pulfrich in his "Ueber Photogrammetrie aus Luftfahrzeugen u. die ihr dienenden Instrumente" (Jena, 1919).

The interpolation of the position of exposure in space is described next. The angles subtended at the camera by the lengths of the three sides on the ground are computed from the co-ordinates of the three points as measured on the negative, and from the known distance from the optical centre to the rear principal point of the lens. The ground lengths are computed and complete the data necessary to a solution. The computations (partly graphic and based on a pyramid construction) are given. Some particular examples of interpolation in space from more than three points show probable errors of the order of 1 metre in each of the three directions, whilst new points fixed by intersection show similar errors.

The sequence of work in field and office is well treated, for it bears the stamp of practical experience. The addition of names and the examination on the ground may be done upon a mosaic made from the photographs taken vertically. The authors claim that 1 square mile can be mapped at 1/10,000 at a cost of about £6 (pre-war prices), but much reliance can hardly be placed on these figures. Even if the authors have overstated their case they have presented it in a well-illustrated and arranged form and add a valuable history and bibliography of survey from air-photographs.

H. S. L. Winterbotham.

GENERAL

The Italian Emigration of Our Times.— Robert F. Foerster. Cambridge, Mass.: Harvard University Press; London, Milford. 1919. 12*s*. 6*d*. net.

Few, even among the warm friends of Italy, can have grasped the extent and importance of Italian emigration during the last twenty years of the old century and the first fourteen of the new. We may have a general idea of the numbers that go to one or two countries, but it is not till we are brought face to face with a full statement of the facts, as in this exhaustive study by Dr. Foerster, that we can see the phenomenon in something approaching its true perspective. In round numbers, some 4,000,000 Italians have permanently settled in other countries, while the temporary emigrants have amounted to about double that figure. When it is remembered that virtually the whole of this emigation goes to foreign countries, Italians have good grounds for claiming that they are entitled to some white man's land to which they may direct

* The same idea had been used earlier by Kapteyn at Gröningen in his "parallactic micrometer" for the measurement of celestial photographs.—Ed. *G.J.*

their superfluous population. For, specially in the warmer regions, they maintain their national characteristics and language without being readily absorbed by their neighbours. Thus at Sta. Tereza in Brazil the Poles now speak Italian. Dr. Foerster insists on the loss that civilization would suffer if a race so gifted artistically, whose labour is always welcomed where artistic qualities and neatness and finish are required, were to lose its individuality altogether when it is obliged for economic reasons to go into exile ; and he would gladly have seen Tunis, where the Italians, thoroughly race-conscious, do especially well and already far outnumber the French, definitely assigned to Italy. Tunis may in fact, almost be called a Sicilian colony.

Dr. Foerster deals in full detail with the emigration to the principal European countries—France, Germany, and Switzerland, where many Italians have permanently settled, and Austria-Hungary, emigration to which had been rapidly dwindling before the war, since the conditions were becoming no better there than at home. As is well known, all the great Alpine tunnels were built almost entirely with Italian labour, and it is as navvies that Italians have done their best work in the United States. Naturally, the emigration to the United States, which is almost entirely from the backward southern provinces and largely urban in character, is here discussed at considerable length. It is in the Argentine, however, that Italian emigrants have found their greatest opportunity. Indeed, Dr. Foerster considers that the prosperity of the country is due almost entirely to their efforts. They have gone everywhere. They are found in great numbers not only on the land, but in business and as sailors, while they perform the tasks of general labourers, which fall to the lot of Italians throughout the world. Dr. Foerster gives a well-informed account of the conditions at home which have made this emigration a necessity, laying special stress on the lack of education and the general backward condition of the south, which cannot possibly absorb the enormous surplus of births over deaths in its present state, if indeed it ever could. But he thinks that the emigration will help to right the conditions that have caused it, owing to the lessons learnt by the emigrants, and the growing strictness of the emigration laws. He is not afraid to emphasize the seamy side of his subject, and there are plenty of black pages in his book, especially when he writes of Brazil and the United States. Had we space, we should be inclined to quarrel with some details in his estimate of the Italian character. The book is, however, an admirably thorough piece of work, which should be studied by every one who is interested not merely in Italy, but in the whole question of emigration.

L. C. M.

Modern Travel : A Record of Exploration, Travel, Adventure and Sport in all parts of the World during the last forty years, derived from personal accounts by the Travellers.— Norman J. Davidson, B.A. (Oxon.), Author of 'Romance of the Spanish Main,' etc. London : Seeley, Service & Co. 1921. *Price 25s. net.*

On reading the title one wonders how a record of exploration, etc., during the past forty years can be contained in a single moderate-sized volume. The contents are a collection of abstracts from books of travel, and all that the words referred to can mean is that the journeys were made not more than forty years ago. The authors whose works have been put under contribution are very various, and the principle adopted in their selection is not quite obvious ; they include missionaries, sportsmen, and naturalists, and the kind of information they furnish depends much on the purposes for which the

journeys were undertaken. In some abstracts it is the country which is more particularly described, in others the natives and their habits, and in others again animals or birds are the chief features. Readers will therefore find variety in these pages, and many may learn all they wish to know of the journeys in this compact form. The illustrations are generally clear and instructive. W. A. T.

Cours de Géographie.— Prof. I. Halkin. Namur: A. D. Wesmael-Charlier. Vol. 1, pp. 160, *price* 2.25; vol. 2, pp. 120; vol. 3, pp. 208.

These little books are intended for lower forms, and deal respectively with general geographic ideas and Europe, parts of the world outside Europe, and the geography of Belgium and the elements of general geography and cosmography. They are clear, simple, interesting, well illustrated, and fairly well printed, but on poor paper, and wretchedly bound. Their general accuracy is beyond criticism, but there are one or two dubious or misleading statements, *e.g.* that the Aletsch glacier is the largest in Europe (p. 35); and the comparisons of the English railways—L. & N. W. R. "de Londres à Liverpool" with Midland "de Londres à Glasgow," or L. & S. W. R. "de Londres à Penzance" with G.W.R. "de Londres à Bristol" (p. 68)—are distinctly unfortunate

THE MONTHLY RECORD

EUROPE

Tropical Drift Seeds on the Irish Coasts.

THE subject of the transport of seeds from one part of the world to another by ocean currents has received a good deal of attention of late, especially from Dr. H. B. Guppy, in his book 'Plants, Seeds, and Currents in the West Indies and the Azores' (see review in *Journal*, vol. 51, p. 399). It has long been known that tropical seeds are from time to time picked up on the western coast of Ireland, but until quite lately no systematic attempt had been made to bring together all the records of such finds, and to discuss the origin and mode of transport of the seeds. This has now been done by Mr. N. Colgan in the *Proceedings of the Royal Irish Academy* (vol. 35, Sect. B, No. 3, 1919). Mr. Colgan points out that in the case of tropical seeds carried to Ireland there can be no question of the spread of plants to a new habitat, for although many of the seeds are capable of germinating when found, the plants could not establish themselves in a climate so different from that of their original home. But the subject is none the less of interest from the light which it throws on the currents of the Atlantic and the possibilities of transport of seeds in general. In the first part of the paper the writer brings together all the records he has been able to find of the stranding of tropical seeds on the British shores, his first quotation being over a century earlier than the earliest usually given. It is from the 'Adversaria Nova' (1570) of Mathias de Lobel, who speaks of rare beans found in great plenty on the shores of Cornwall. Other early writers quoted are Sir George Mackenzie (*Phil. Trans.*, 1675), Sir Hans Sloane (*Ibid.*, 1696), Robert Brown (1818), and an anonymous writer in 1823, after which no further record seems to exist until quite modern times. The earliest references are undoubtedly to the bean of *Entada scandens*, the well-known tropical climber whose seeds are sometimes made into matchboxes, and this stands first in the records of Irish drift, both for extension of

range (Kerry, Clare, Galway, Mayo, Donegal, and Antrim) and frequency of occurrence. Altogether eight species can be identified with more or less certainty, five besides the *Entada* being of the Order Leguminosæ (*Mucuna*, *Guilandina*, etc.). Discussing the origin of the Irish tropical drift, Mr. Colgan fully considers the possibility of human agency, some of the seeds being not infrequently collected by travellers and sailors; but after quoting all that is to be said on this side, he finds the case for the transport by natural means almost unanswerable. Although the old idea of the Gulf Stream as a continuous current from the Gulf of Mexico to our shores must be given up, there is abundant evidence of a means of transport for the whole of that distance through the co-operation of currents, drifts, and winds; the latter stage of the transit, namely from the mid-Atlantic, where the permanent Gulf Stream ceases to act, is probably effected by irregularly recurrent spells of westerly and south-westerly winds, which accord with the irregular intervals at which the seeds have been found. Some of these belong to species from the deltas of the Amazon and Orinoco, whence they have probably been carried first into the Gulf of Mexico.

Types of Farm Buildings in France.

In one of the instructive studies on anthropogeography which we have learnt to expect from Prof. Demangeon, that French geographer discusses, in the *Annales de Géographie* for 15 September 1920, the different types of farmhouses in France, showing their close connection with the varying character of the rural economy. Originally, no doubt, such buildings expressed an intimate relation with the purely physical nature of different parts of the country, according as stone or wood or merely earth was available for their construction. But with the improvement of communications any decided demarcation between different types from this point of view is rapidly being lost. Yet great differences of type still persist in respect of the general arrangement and internal construction of farm buildings. Prof. Demangeon draws a sharp contrast between the state of things in France and that in Great Britain, in which last he states (perhaps somewhat too sweepingly) that only one type of farm prevails, whereas in France he defines at least four, with minor varieties within them. These are: (1) the elementary house, in which all the parts, including the granary and cattle-shed, are under one simple roof, and all on the ground-level; (2) the farm in close order, in which all the individual parts are close together (sometimes enclosing a yard), though the dwelling-house is kept distinct from the cattle-sheds, etc.; (3) the farm in open order, in which the human inhabitants are still further separated from their live-stock; and (4) the raised building, of two or more stories, again under a single roof, but in which the farm people and their goods are shifted to the upper stories, while the live-stock remains on the ground floor. The distribution in space of these four types is governed by differences in the character of the farming (*e.g.* whether mainly agricultural or pastoral) and the scale on which it is carried on in different parts of the country. The first, particularly suitable to the *petite culture* so general in France, is the most widely spread, and for this very reason presents the greatest number of regional varieties. In that seen in Lorraine and neighbouring districts an impression of massiveness and compactness is combined with one of roominess and space—as much as possible, both of crops and live-stock, being brought together under the single roof. The second is found in a compact area in the north of France, its most characteristic form being the Picard or Walloon; but it occurs in scattered areas

elsewhere, as on the fertile plateaux round Paris. It is specially appropriate to farming on a large scale. The third type, which gives more freedom to the farm people and allows greater development of stock-raising, appears above all under the mild littoral climate of Flanders, Picardy, and upper Normandy. The farm of two or more stories, which implies a certain rise in the social scale as evidencing a desire of the farm people to be less intimately associated with their live-stock, is characteristic of a large part of the centre and south of France, including a portion of the Alps. Prof. Demangeon asks whether the affinities noticeable with types in other parts of Europe do not imply that other than local influences have been at work also, such affinities being due to historical relations between the peoples. The paper is well illustrated by reproductions of photographs.

Currents along the Baltic Coasts.

A warm surface current flows along the whole southern and eastern shores of the Baltic, but though the broad fact has long been realized, few detailed and accurate observations of the conditions of flow exist. An attempt to supply this want has been made by Dr. R. Brückmann, whose researches on changes of the Baltic coasts within historic times are well known to geographers. He has attacked the subject both by means of bottle-records (having thrown into the sea a large number of bottles, with the necessary statements enclosed, at various points along the coasts) and by direct observation of the currents, though this last method was beset with many difficulties. The results are published by him in vol. 22, part i., of the *Forschungen z. Deutschen Landes- und Volkskunde.* Such studies, he points out, are important in connection not only with the physical conformation of the coast, but with the economic relations. The current in question has provided the material both for the *Nehrungen*, which close the lagoons (*Haffe*) of the Prussian coast, and for the moving dunes which cause so much trouble in many parts of the same. In at least one case—that of the fishing-port of Neukuhren—better knowledge of the conditions would have obviated mistakes in the selection of a site for such a purpose. For the German fishery, too, fuller knowledge is very desirable. Of the 116 bottles employed in the investigation 52 were thrown in in autumn, 64 in spring, and the percentages of those recovered were 67·3 and 48·4 respectively. The rate of travel varied greatly, the maximum being 30·4 cm. per second, the average 8·1 cm. Of those recovered, 90 per cent. had moved to the east and north. A careful study of the wind conditions on this coast shows that the yearly percentage of westerly winds is 45·1, so that wind may be safely put down as the chief cause of the current, this being checked for a time when strong easterly winds prevail, but soon resuming its course when their strength moderates. In the latter part of the paper Prof. Brückmann deals with the movements of sand along the coast, showing how this is illustrated by the change in the submarine contours at various points between the dates of successive surveys.

ASIA

Sinai Desert Winds.

The Scirocco winds of the Sinai Desert, which resemble the Egyptian Khamsin, appear to have had some influence upon the conduct of German military operations on the Sinai front, and a discussion of the subject by W. Späth appears in the *Meteorologische Zeitschrift* (1920, Heft 182), on the basis of observations made at a German meteorological station at El Arish during

1916 and 1917. The scirocco in question is a S.E. föhn which, blowing over the Djebel Makrah, Djebel Ililal, and Djebel Magara, descends with great force on to the coastal lands, where it arrives heated by adiabatic compression to the extent of some 4° C. (*circ.* 7° Fahr.). The actual extreme temperature recorded during the prevalence of a wind of this type occurred at Birsheba in May 1916, when the thermometer rose to 43·1° C. (109·6° Fahr.). It is stated that inside tents considerably higher temperatures have been noted—up to 60° C. (140° Fahr.). The scirocco is favoured by low pressure out in the Mediterranean, and occurs chiefly in April and May at the end of the rainy season and again in the autumn before its renewal. Inland the wind often persists day and night, but on the coast it sets in about 7 a.m., attains its greatest force about 11 a.m., and gives place by evening to a sea-breeze. In the early morning before the dusty desert wind sets in the landscape is very clear in the dry air ; contours and shadows are sharply defined, while distances seem much foreshortened. It may be noted that the optical quality of "nearness" as an atmospheric effect is by no means synonymous with "visibility," to which aeronautical meteorologists are now giving so much attention.

Middle East Department of the Colonial Office.

The transfer of responsibility for administration and policy in Palestine, Mesopotamia, and Aden from the Departments hitherto dealing with these countries to the Colonial Office took effect on March 1. The Department of the Colonial Office, formed as a result of this transfer, will be under the charge of Mr. J. E. Shuckburgh, C.B., and the services of officers with local experience in the areas in question will be utilized. The Department will deal with questions of policy in other Arab areas within the British sphere of influence, and in this connection the services of Lieut.-Colonel T. E. Lawrence have been secured as Adviser on Arab Affairs.

Origin of the Name Quelpaert.

The origin of the name of Quelpaert Island, near the southern end of Korea, is a problem which has never yet been quite satisfactorily solved. It is generally supposed that the name is of Dutch origin, for one of the first mentions of the island occurs in connection with the unfortunate voyage of the yacht *Sperver*, whose shipwrecked crew landed thereon in 1653, afterwards travelling through the mainland of Korea to Seoul and back. The Linschoten Society has lately published the journal kept by Hendrik Hamel describing the voyage and subsequent travels, from a MS. preserved at the Hague, and the origin of the name Quelpaert is fully discussed by the editor, Mr. B. Hoetink. It is certain that the name was not given on the occasion of the voyage of the *Sperver*, for the island is mentioned as "Quelpaert" in a document of 1648. At that date the word was used by the Dutch in the East to designate a type of vessel also called a galiot, and the Colonial records show that the first of its kind to be used in the Far East was the *Brack*, sent out as an experiment in 1639. This ship is spoken of variously as the "Quel de Brack," "'t Galjot 't Quelpeert," "t' Quelpaert,' "t' Quel," "'t Galiot den Brack," and even as "t' Galiot t' Quelpaert de Brack." Being for a time the only ship of the kind in those waters it was often spoken of by the generic term only, but when others appeared (*e.g.* the *Hasewindt*, the *Visscher*, etc.) the actual name of each came to be added. The probability seems to be that the island was discovered by the *Brack* during a voyage to Japan in 1642, though the records are silent about such a discovery. All this still leaves obscure the derivation

of the word *Quelpaert*. The editor of Hamel's journal makes the tentative suggestion that, like "galiot" itself, the word may have been taken over from the Portuguese, and that it may have been formed (on the analogy of "leopard") by combining with the generic term *pardus* a specific designation—*quelly* or *quel*, explained in Bescherelle's French Dictionary of 1851 (s.v. *Quelly*) as the name of a species of leopard found in Guinea. There seems no doubt that the first two letters represent a hard guttural, being found as such in other names used by the Dutch at the time (though generally preceded by *c*) as in "Nangasacqui" (Nagasaki).

Volcano Studies in the East Indian Archipelago.

Dr. W. van Bemmelen, the well-known Director of the Batavia Observatory, has lately reached Europe on furlough, after ten years' continuous service in the East. Besides his more special work in meteorology and magnetism he has made useful contributions to the geography of the Archipelago, chiefly during trips to the great volcanoes of that region. In 1908 he took part in the expedition to Krakatoa, and sounded the marine basin partly enclosed by the islands remaining after the great eruption (see *Journal*, vol. 37, p. 315). He also made the ascent of Mount Rinjani in Lombok, and sounded its Caldera lake, also visiting Mount Korintji in Sumatra. In company with Dr. Boerema he made soundings and temperature measurements in the remarkable hot acid lake of Mount Idjen, and sounded the crater-lake of Mount Kloet, descending into the now empty crater a few days after the eruption of 1919. He also witnessed secondary eruptions of Mounts Bromo and Tangkoeban Prahoe in Java, and visited many others of the great volcanoes, securing excellent photographs. Besides articles in Dutch periodical publications, he has given popular accounts of his journeys in a book entitled 'Naar hooge toppen en diepe kraters,' published at Leiden. Some of his more specially scientific work has been done in connection with the meteorological stations established by the Batavia Observatory on the tops and slopes of some of the volcanoes. We understand that he will shortly contribute an illustrated article to the *National Geographic Magazine*.

Prof. Molengraaff's Paper in the February Number: Errata.

In the table on p. 114 the word *submersion* is to be transferred to the previous line (following "no fringing reefs" after a semicolon), and does not refer to the last two lines at all. The reference on p. 113 is to the following publication: B. G. ESCHER, "Atollen in den Ned. O. I. Archipel.," *Med. Encyclop. Bureau*, XII., Batavia, 1920.

Srimangal Earthquake of 8 July 1918.

In the latest issue of the *Memoirs of the Geological Survey of India*, vol. 46 (1920), pp. 1–70, Dr. Murray Stuart gives an interesting account of a destructive earthquake in Assam on 8 July 1918. The epicentre lies about $3\frac{1}{2}$ miles south of Srimangal station, and (using Dutton's method) Dr. Stuart estimates the depth of the focus at between 8 and 9 miles. One of the most valuable results is that obtained by the re-levelling of the epicentral district along the line from Silchar to Comilla. First carried out in 1911–12, and repeated in 1919–20, a comparison of the two series shows that to the north-east of the epicentre there has been no appreciable change of level, but that on the other side, from 6 to 30 miles from Srimangal, the ground has subsided from $1\frac{1}{2}$ to 9 inches, suggesting that the earthquake was caused by a downward slip on the southern side of a normal fault situated below the longer axis of the epicentral area.

Typhoons of the Far East.

In view of the shipwrecks that have occurred in the China and neighbouring seas, from vessels being caught unawares in cyclones following unusual tracks, Father Louis Froc, S.J., Director of the Zikawei Observatory, Shanghai, has brought out an atlas (1920) showing the tracks of the 620 "typhoons" which occurred during the twenty-six years 1893–1918. The term is applied to cyclones, usually bred out in the open Pacific near the Tropic, which move towards the coast of Asia. The charts show for the various months of the year the mean distribution of pressure in the vicinity of eastern Asia, together with the individual paths of all the cyclones recorded in the same months, an arrangement much more useful to sailors than a representation of mean paths only. It is seen that while the great majority of storms travel in a north-westerly direction towards the coast of Asia, a few take a south-westerly course. On reaching the continent many penetrate inland during the hot months, but during the cold season, when pressure is high over the continent, the storms recurve in a north-easterly direction out to sea again. The typhoon season comprises the four months July to October, the monthly averages being respectively 3·4, 3·5, 4·2, 3·7. The height of the season is thus September, the annual number of 4·2 representing a total in the twenty-six years of 110. Why September should be the "black" month is by no means obvious, but the reason may be perhaps connected with minor peculiarities in the pressure distribution of that month not apparent on the general charts. It is interesting to note that, in general, tropical cyclones, to which category of storms "typhoons" belong, develop on the edge of the belt of equatorial calms on the western flank of the oceanic "highs" over expanses of open ocean to the east of great land-masses. The normal course of these revolving hurricanes, north-westerly recurving north-easterly in the northern Tropic, and, correspondingly, south-westerly recurving south-easterly in the southern, is a clear indication that the direction of travel is governed by the steady upper current of the return or Anti-Trade.

AFRICA

The Future of Rhodesia.

The Colonial Office has announced the appointment of a committee, with Earl Buxton as chairman, to advise the Secretary of State on questions affecting the future of Rhodesia. These refer to the possible granting of responsible government to Southern Rhodesia, the working out of a Constitution, and the carrying on of the Administration for the time being by the British South Africa Company; the future of Northern Rhodesia will also be considered.

The Oasis of Siwa.

Mr. F. A. Edwards calls attention to one or two slips made by Mr. W. Seymour Walker in his summary of modern explorations in the oasis of Siwa, published in the January 1921 number of the *Journal* (pp. 29–34). The first modern traveller to the oasis should have been given as William George Browne, not John Browne (pp. 29, 31, and 32), and his visit was in 1792, not 1797. Minutoli again (his full name was Heinrich Freiherr von Minutoli) was there in 1820, not 1827 (p. 31), and Steindorff (p. 32) in 1899, not 1896. Mr. Jennings-Bramly's name has no *e* in the second part. Besides the travellers mentioned by Mr. Walker, various others have visited and described the oasis, and Mr. Edwards sends a list of the most important, with bibliographical references, which will be placed in the Library for the use of those interested in the subject.

Early Portuguese Knowledge of Lake Nyasa.

It is well known that some knowledge of Lake Nyasa was gained by the Portuguese long before its re-discovery by Livingstone: the lake in fact had regularly taken its place, under the name Maravi, as the long narrow sheet of water stretching north-west indefinitely into the interior shown in the maps of the eighteenth century, particularly D'Anville's. But the circumstances under which information about the lake was obtained, in the first quarter of the seventeenth century, are far from generally known, and the clear statement thereon by George Schurhammer, S.J., in *Stimmen der Zeit*, 1920, Heft 4, is therefore of interest. At the time in question the Portuguese had been debarred from the Red Sea coasts by the Turks, and access to the Jesuit missions in Abyssinia was therefore a matter of difficulty, so that the authorities of the Order cast about for some other possible route thither from the coast. Early in the seventeenth century a quondam Negro slave had attained to power in the region of the lower Zambezi, taking the grandiloquent title of *Homesura*, or "All-Compeller." Certain Portuguese who had aided him in his conquests brought back news of a great lake stretching north from Maravi, the head-quarters of the chief, and it was felt that this might offer a means of penetration towards Abyssinia. The matter was taken up by Father Palmeiro, "Visitor" of the Jesuit missions in India (Goa), to which those in East Africa were then subordinate, and he sent directions to Father Luis Mariana to inquire into the possibilities of the route. He did so, and in 1624 made an interesting report to the Visitor, who in turn passed on the information to the General of the Order. The report exists in MS. in a volume entitled 'Goana Historia, 1600–1624,' and has been printed by Beccari in vol. 12 of his great collection of documents on the early history of Æthiopia, where however it is to some extent lost in the mass of other matter. Father Schurhammer gives the report in a German translation, and is able to correct one or two mistakes made by Beccari in his version. Most other writers have depended on an abridged Latin version of the report. Mariana described the outlet of the lake by the Shire (Chere) and some of the countries on its shores, as well as the means of navigating it. He considered it to stretch at least as far as the latitude of Mombasa, which may possibly imply that his informants made the not unnatural mistake of considering Nyasa and Tanganyika as one piece of water: it may however be merely due to the common habit of exaggerating distances on the way to the interior—so fruitful a cause of error in the early maps of Africa. Mariana was not deceived as to the difficulties and dangers of an attempt to reach Abyssinia by this route, but although he could find no one willing to undertake such a venture, he expressed his readiness to try himself, if so ordered. The idea was given up, however, the authorities being moreover discouraged by the failure of attempts made at the same time to penetrate inland from Melindi and Zeila.

OCEANIC ISLANDS

Appeal for the Inhabitants of Tristan da Cunha.

The inhabitants of the lonely island of Tristan da Cunha in the South Atlantic occupy a unique position among the subjects of the British Crown. Lying entirely off the frequented ocean routes they are rarely visited by ships, and being unable to produce all the necessities of life they have depended in part even for these on the casual help afforded by generous people in this country. In 1885 the islanders suffered a serious disaster, from which they have never quite recovered, in the loss by drowning of fifteen out of sixteen

male adults through the foundering of a boat while attempting to relieve a ship in distress. Their great need is, however, felt to be that caused by the absence of all means of education and spiritual instruction, for although forming an Anglican community under the diocese of St. Helena, there has been—apart from a period of three years—no resident clergyman since 1889. An appeal has now been made by Mr. Douglas M. Gane for help from private sources to remedy this state of things. Should a sufficient fund be raised it is hoped that the services of a clergyman may be secured, who would work under the Society for the Propagation of the Gospel. Failing this, a lay schoolmaster might be appointed. The islanders, who now number 119, are described as fully deserving of consideration, being truthful and honest, brave and generous, well-mannered and industrious. Their maintenance in the island under suitable conditions is also of serious importance to the Empire, both as preventing annexation by another Power (and the danger which might arise in this case is shown by the use to which the island was put by the United States during the American War of 1812–15), and as a succour to shipwrecked seamen. Donations may be sent to the National Provincial and Union Bank of England, 15, Bishopsgate, E.C. 2, to the credit of the "Tristan da Cunha Fund."

MATHEMATICAL AND PHYSICAL GEOGRAPHY

Ice Observation in the North Atlantic.

In consequence of the *Titanic* disaster steps were taken to organize an International Ice Observation and Patrol Service in the North Atlantic, the management of the service being entrusted to the United States Coastguard. The work was begun in 1913 and continued during the next three years, when the conditions which culminated in the entry of the United States into the war broke it off temporarily, but it was resumed in 1919. By the courtesy of the British Foreign Office we have received a copy of a report issued in 1920 at Washington by the United States Coastguard (Bulletin No. 7) dealing with the work done in 1916 and 1919 and the general conclusions to be drawn from the observations, which have thrown interesting light on the ice-conditions and ocean currents of the region in question. By ice-observation is understood the examination of the conditions in the early part of the year (in February and March) in the neighbourhood, chiefly, of the Newfoundland Bank, while the Ice Patrol signifies the look-out for ice during April, May, and June in the vicinity of the steamer routes across the North Atlantic. This patrol was carried out in both years by two of the Coastguard cutters, working alternately a fortnight at a time. During both stages a regular system of disseminating the data collected by means of wireless telegraphy was maintained. The season of 1916 was remarkable for the little ice of any sort that menaced the Trans-Atlantic steamship routes. Of the bergs seen, the greater number were north of 46° N. In May the Labrador Current was weak while the Gulf Stream was strong and close to the Grand Bank, thus hindering the southward drift of the bergs. In June valuable observations were secured of the disintegration of bergs brought into the influence of the Gulf Stream, the rapidity with which they broke up and melted being very striking. It is thought that the relative strength of the Labrador Current is governed more by barometric pressure than by wind, though the wind conditions resulting from the former would reinforce its direct action. In 1919 again the strength of the Gulf Stream impressed the observers during the earlier part of the season, it being found unusually far to the northward in April, while the Labrador Current seemed to

be dammed back. Early in May, too, the latter current had been forced farther west than usual and few bergs were seen, but in the latter half of the month the current was much stronger and its temperature 6° colder than it had been in April in the same latitude. On May 25 an S.O.S. was received from the British ship *Cassandra*, which had struck an iceberg in 47° 31′ N., 51° 22′ W., but assistance was after all not needed. During June a good number of bergs were seen near Cape Race and in the neighbourhood of the Grand Banks, and their drift and disintegration were observed. During both seasons scientific observations were made by Mr. A. L. Thuras, whose report on the work in 1919 is printed in the Bulletin under notice. It included observations of density, electrical conductivity, and chlorine content.

GENERAL

Forests and Human Progress.

Under this title Mr. Raphael Zon summarizes conveniently, in the *Geographical Review* for September 1920, the various ways in which man has been affected in the past by the great forests of the world, and the importance for the future of the new movement towards re-forestation and rational management. In the earliest times man was largely dominated by forests, which were obstacles to migration and colonization, often playing the part of boundaries separating tribes or nations, or serving as refuges for weak and undeveloped tribes, while the earliest civilizations arose in the more open regions. Special ways in which the forest has acted on man are by regulating his distribution by their provision of fuel-supply, or by moulding his religious beliefs and folk-lore. A new stage is reached when man begins to gain ascendancy over the forest, which he can only do after advancing considerably in civilization. Forests have tended to disappear not only through clearing for agriculture, but through the exploitation of the forest products both as timber and fuel for industries, and their destruction has been aided in the past by the existence of rivers as means of transport ; with the introduction of other facilities, the importance of river-transport becomes less. Broadly speaking, the advance of civilization has always meant reduction in the forested areas, the tendency having been only slightly checked by legal protection of woodlands ; while on the other hand the decline of an early civilization has permitted the forest to regain some of its lost ground, as is evidenced by the remains of antiquity now completely overgrown by jungle. The struggle with the forest has exercised an important psychological influence, as in the American backwoods, where it has helped to develop strong and self-reliant character, combined no doubt in early days with some amount of coarseness. As is well known, the colonization of forest regions by man has led to a complete change in the composition of the forests left standing : this is well shown in Germany by the spread of coniferous at the expense of broad-leaved forests, the greater prevalence of the latter in early days being indicated by the larger number of place-names derived from their component trees, as compared with those derived from the names of conifers. Many have been the social and economic evils of forest destruction, particularly in mountain regions, where it has induced a torrential character of the streams, with more intense erosion and a liability to floods, and to some extent an actual change of climate. Old forest land has often proved quite unsuited for agriculture and has become a useless waste : in the United States alone there are over eighty million acres of such idle waste land. An appreciation of the value of forests and of the need for rational management is fortunately now general throughout the civilized world,

and though the man-made forests may lack the beauty and grandeur of the wild woods, they are still an important factor in civilization.

Absence of Carbonate of Lime Deposits from deep Ocean Basins.

With reference to the remarks on this subject by Prof. Molengraaff in his paper on the 'East Indian Archipelago' in the *Journal* for February (vol. **57**, pp. 98–99), Mr. F. F. Southby has written to suggest as a possible explanation the capacity of water at high pressures to dissolve substances insoluble under ordinary conditions. In the deep basins of the Archipelago, he thinks, under the enormous pressure of 700 atmospheres, $CaCO_3$ may be soluble at 3° C., and at a lesser depth in the warmer waters. He suggests that the matter might be tested by experiment considering the great pressures now obtainable artificially. We referred this suggestion to Prof. Molengraaff, who discusses the question in a letter sent in reply. He says that the possible effect of pressure had suggested itself to him, and that experiments are at present being made at Utrecht by his colleague Prof. Cohen. Even if it should be demonstrated that great pressure should materially increase the solubility of $CaCO_3$ in pure water (*i.e.* free from CO_2, the absence of which is considered to reduce the solubility under ordinary pressure from 1 : 1000 to 1 : 10,000 or less), the difficulty is not entirely removed. Dr. Molengraaff points out that the bottom water in enclosed deep basins is generally supposed to be completely stagnant (in the Black Sea it is even putrid for this reason), so that the layers adjacent to the bottom would soon become saturated, rendering further solution impossible. He puts forward a tentative solution of the difficulty as follows : Below the deep basins the geo-isotherms are closer together than in the surrounding areas, so that the heat of the Earth's interior will flow off more rapidly at the centre than at the margins. This may, he thinks, set in motion a very weak and slow but continuous convection current, the slightly warmer water ascending at the centre of the basins and being replaced by colder water from the sides. This latter will contain oxygen in solution, and will thus be able to oxidize organic matter and generate CO_2, by which fresh amounts of $CaCO_3$ will be continuously dissolved. The suggestion is ingenious, but at present can hardly be regarded as more than an hypothesis. It may be asked, *e.g.*, whether the supposed temperature difference would not be detected by the delicate instruments now in use for oceanographic research.

Permanent Committee on Geographical Names.

With the present number is included the first list of names published by the Permanent Committee : a general list of European place-names, mostly of towns. It is the present intention of the Council to insert such lists loose in the *Journal*, in order that they may be collected for easy reference. Additional copies of the lists will be on sale by the agents for the sale of the *Geographical Journal*.

OBITUARY

Prince Kropotkin.

THE announcement of the death of Prince Peter Alexeivich Kropotkin on 8 February, in a small town near Moscow, where he was virtually interned, will have been received with regret by a wide circle of all classes and all creeds. He had left England, which had been his home for many years, for Russia in

1917, after the revolution had broken out, no doubt with the hope that his "anarchist" aspirations would be realized on a large scale. It need hardly be said that he was grievously disappointed. But this is not the place to deal in detail with Kropotkin's political views, except to express regret that his absorption in these seriously diminished the services which otherwise he might have rendered to Geography.

Prince Kropotkin, descended from one of the oldest princely houses in Russia, was born in the "Old Equerries' Quarter" in Moscow on 8 December 1842, so that when he died he had entered on his seventy-ninth year. In this aristocratic quarter, surrounded by troops of serfs, he spent his first fifteen years. He and his brother Alexander, who were devoted to each other, received a somewhat irregular education from private tutors—French, German, and Russian. The education was mainly literary and historical. So keenly interested in literature was Kropotkin even then (aged thirteen) that he started a review which continued for two years, till he had to leave for St. Petersburg. His father had determined that his sons should enter the Army, and at the age of fifteen Kropotkin, much against his wishes, was admitted to the Cadet Corps, or Corps of Pages, which received only 150 boys, mostly children of the nobility belonging to the Court. Those who passed the final examination could enter any regiment of the Guards or of the Army they chose, while a certain number were attached as pages to members of the Imperial Family. After all, Kropotkin became reconciled to the School, and spent quite an interesting and useful five years going through the various forms. He at first found the lessons so easy that he had plenty of time for private reading. In time, he took up various sciences, Physics, Chemistry, Mathematics, Geography, Cartography, and both in classes and by himself he made considerable progress in this direction.

When in 1863 he had passed his final examinations, in which he took high rank, he had to decide what regiment he wished to enter, it being expected that, like his fellow cadets, he would choose one of the most select—some regiment attached to the Court. But to the consternation of his father and his comrades he decided to join the Mounted Cossacks of the Amur, a new and undistinguished regiment. He had long been interested in Siberia and its geographical problems, especially those connected with the Amur and the Usuri. By selecting a Siberian regiment he would have ample scope for exploration in little-known Eastern Siberia. During his five years in Siberia he had opportunities for carrying out exploring and survey work on the Amur and in Manchuria, the maps of which abounded in blanks and errors. Later still, he explored the Western Sayans, and caught a glimpse of the Siberian Highlands. Finally, he undertook a long journey to discover a direct communication between the gold-mines of the Yakutsk province and Transbaikalia. All this proved of great service to Kropotkin when, after his return to Europe, he took up the difficult problem of the structure of Northern Asia.

In time, Kropotkin and his brother Alexander, who was stationed at Irkutsk, became more and more interested in the revolutionary movements which were developing in Russia and other European countries. They decided to leave the Army and return to St. Petersburg; this they did early in 1867. Kropotkin entered the University, where he worked hard for five years mainly on scientific subjects, devoting special attention to geography. He became intimately associated with the Imperial Geographical Society in his capacity of secretary to its section of physical geography. But his main geographical interest at this time was the vast problem of the Orography of Northern Asia,

the maps of which he considered were "mostly fantastic." This led him in time to extend his investigations into Central Asia. He not only made use of the results of his own travels in Siberia, but with infinite labour collected all the barometrical, geological, and physical observations that had been recorded by other travellers. This preparatory work took him more than two years; followed by months of intense thought to bring order out of what seemed a "bewildering chaos." Suddenly the solution flashed upon him. The structural lines of Asia, he was convinced, did not run north and south or east and west, as Humboldt represented them, but from north-east to south-west. This work he considered his chief contribution to science. A summary of this investigation, which he gave to our Society some years later, was published in the *Geographical Journal*, February and March 1904, as well as another on the Desiccation of Asia, *Geographical Journal*, June 1904.

The next important geographical work undertaken by Kropotkin at the request of the Imperial Geographical Society was a journey through Finland in 1871–72 to study the glaciology of the country. He returned with a mass of most interesting observations. After a visit to Western Europe, Kropotkin returned to St. Petersburg, and in 1874 presented his report on Finland. This he did at a meeting of the Geographical Society, where it was keenly discussed. A day or two later he was arrested, and finally imprisoned in the terrible fortress of St. Peter and St. Paul, but was permitted to finish his work on the Glacial Period in Finland and in Central Europe, which with his *magnum opus* on the Orography of Asia was published after his escape, while he was residing in England under the name of Levashoff. In April 1876 he had been transferred to another prison, and in a few days placed in the military hospital. The romantic story of his escape from this hospital is well known. He had no difficulty in passing through Finland and Sweden to Christiania, where in a British steamer he crossed to England, landing in Hull, and going on to Edinburgh. As he had to work for his living he began to send, in his assumed name, notes, mainly geographical, to *The Times* and *Nature*. He ultimately moved to London, between which and France and Switzerland he migrated, until, after two years' imprisonment in France, he finally settled down in London, where he remained with few intermissions till his unfortunate return to Russia in 1917. He soon formed literary connections in England in addition to *The Times* and *Nature*. He wrote largely for the *Nineteenth Century*, through which he ran his two well-known books, 'Fields, Factories and Workshops,' and 'Mutual Aid among Animals.' To the eleventh edition of the *Britannica* he contributed most of the Russian geographical articles. Of course he soon made himself at home at our Society, and was a valued contributor to the *Journal*. Among his contributions to the *Nineteenth Century* was an article in December 1885, entitled, "What Geography ought to Be," which is well worth reading. It is based on the Report on Geographical Education issued by the Society in that year, and gives a comprehensive view of what he considers the field of geography ought to be, its value from the scientific and practical standpoint, and the place it ought to hold in education. "Surely," he says, "there is scarcely another science which might be rendered as attractive for the child as geography, and as powerful an instrument for the general development of the mind, for familiarizing the scholar with the true method of scientific reasoning, and for awakening the taste for natural science altogether."

Unfortunately, Kropotkin had never again an opportunity of doing active work in the field of scientific exploration. He became more and more absorbed

in the promotion of his socialistic or rather anarchist views, and suffered more and more from the consequences of the hardships he had to endure in prison. In his later years he became almost a chronic invalid, wheeled in a bath chair about Brighton, where he lived for the last few years. His main contributions to geography are the records of his explorations in Eastern Siberia and the discussion of the great problems which they suggested to him, and his investigations into the Glaciology of Finland. He was a keen observer, with a well-trained intellect, familiar with all the sciences bearing on his subject; and although his conclusions may not be universally accepted, there is no doubt that his contributions to geographical science are of the highest value. He made many friends in England. He had a singularly attractive personality, sympathetic nature, a warm but perhaps too tender heart, and a wide knowledge in literature, science, and art. J. S. K.

Arthur John Charles Molyneux, F.G.S.

Mr. A. J. C. Molyneux was one of those cultured frontiersmen whose influence is so valuable in a new country. He inherited a bent for science from his father, a well-known geologist and coal-mining expert, and was himself trained as a mining geologist. One of a numerous family, he was born in the Midlands about fifty-five years ago, and was still young when the family migrated to Natal, where the father died soon afterwards. The son was in the adventurous band who entered Matabeleland in the early '90's, and he participated in the exciting after-search for Eldorado. He remained a staunch Rhodesian for the rest of his life, making Bulawayo his home or headquarters; and by many exploring trips, both north and south of the Zambezi, he acquired a wide knowledge of the shape and structure of the whole region. He had a keen eye for the physiographical aspects and problems of the country, as well as for its stratigraphical features, and his papers communicated to the Geological Society in 1903 and 1909, the first on Southern, the second on Northern, Rhodesia, contain much of geographical import. His memorable paper on "The Physical History of the Victoria Falls," contributed to the *Geographical Journal* (January 1905), was not only a vivid and accurate description of the wonderful spectacle, but also gave for the first time a scientific account of the surroundings and an adequate explanation of the origin of the Falls. Several other papers were published by him in South African scientific journals, mainly in the *Proceedings* of the Rhodesia Scientific Association. Of this society he was one of the founders and mainstays, serving at one time as its president, and continuously in other offices. He was also active in promoting the establishment and aiding in the management of the Rhodesia Museum at Bulawayo. During the last few years of his life he was attached as Geologist to the Geological Survey of Southern Rhodesia, and was the author of some of its recent reports. His services to geology were recognized in the award to him of the Wollaston Fund of the Geological Society in 1909.

Through all the hardships and vicissitudes of a pioneer's life, his placid and kindly disposition remained unimpaired, and gained him friends everywhere. He rejoiced in the rise and growth of the country of his adoption, and was proud to rank as one of its "old-timers."

Failing health induced him to undertake a short visit to the home-land last autumn with the hope of benefiting from the voyage. But the benefit was transient. He died suddenly on December 28th last, almost immediately upon his return to Bulawayo, and his last resting-place is among old comrades there. G. W. L.

MEETINGS: ROYAL GEOGRAPHICAL SOCIETY: SESSION 1920–1921

Eighth Evening Meeting, 21 February 1921.—The President in the Chair.

ELECTIONS.—Monsieur Emile Babault; Captain Geoffrey Laidlaw Bartrum; Captain John Bates; Charles Albert Cornell; Captain K. C. J. Davies, I.A.; Captain N. B. Favell; Roby R. Jewell; John Wells Larkin; Miss Mabel Mercer; Sidney Scott; Miss Jennie Georgina Skinner, B.A.; Robert Smith; Frederick Leslie Thomas; Arthur M. Toyer; Charles Cyril Turner; Lieut. J. Ulott, I.A.; John Harold Wellington.

PAPER: The Rio Negro, Casiquiare Canal, and Upper Orinoco. Dr. Hamilton Rice.

Ninth Evening Meeting, 7 March 1921.—The President in the Chair.

ELECTIONS.—Lieut. Louis Ernest Ahrens; Herbert Ash; Frederick John Beechman; James Graham Bower; Walter Russell Brown; Arthur B. Carter; J. Rives Childs; Joseph Chown; Captain Basil Laing Clay; Major Francis Jervoise Collas, O.B.E., M.C., R.A.; Captain Wilfred H. Eva, M.C.; Captain Leonard M. Handley, M.C., I.A.; Mrs. Evelyn Hockley; William Jessop; John C. Johns; George Mitchell Kemp; Ralph Stewart Morrish; Captain G. H. R. St. John Owen; William Rushton Parker, M.A., M.D.; Alfred Peters; James Romanes, M.A.; Marshall King Smith; Arthur H. Tatlow; Major D. B. Thomson; Miss D. R. Williams; F. E. Woodall, M.A.

PAPER: The Organization and Equipment of the Mount Everest Expedition.

Tenth Evening Meeting, 21 March 1921.—The President in the Chair.

ELECTIONS.—Hugh Adams; Alfred Dickinson, M.INST.C.E.; Miles Wedderburn Lampson; Lieut. Alexander Gault Macgowan; Captain Lionel Henry Mander; Captain Edward Hamilton Mann, R.H.A.; Joseph Ogden; John Ashby Offer; John Walter Price; Roderick Urwick Sayce; Mrs. Mildred Leo Clemens-Schenck; Maraduke T. Tudsbery, A.M.INST.C.E.; Edward Valpy; Captain Walter Richard Worthington; Captain John William Young, I.A.

PAPER: Present Day Conditions in Spitsbergen. J. M. Wordie.

Fifth Afternoon Meeting, 14 March 1921.—The President in the Chair.

PAPER: Notes on Map Projections.

Colonel Sir Charles Close.
C. T. McCaw.
A. R. Hinks.

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NOTES ON THE KUNENE RIVER, SOUTHERN ANGOLA

F. E. Kanthack, C.M.G., M.I.C.E.

THE Kunene is one of the two solitary perennial rivers draining into the South Atlantic from the South African continent between Benguela (lat. 12° 34′ S.) and Cape Town (lat. 34° S.); that is, over a distance of approximately 1600 miles along the coast. The other is the Orange River 1200 miles further south, and this latter great river, which drains an area of about 336,000 square miles, is frequently reduced to a very small discharge during the spring months, and has on numerous occasions during the past century ceased to flow altogether in its lower reaches. The Kunene and Orange rivers are the northern and southern boundaries respectively of the South-West Africa Protectorate, formerly German South-West Africa. All along its 1200 miles of coast-line a great number of rivers are shown on the maps; all of them are, however, dry watercourses, discharging only at rare intervals.

The Kunene has, in recent years, attracted a considerable amount of attention due to various causes. In the first place, it has become politically important in connection with the settlement of the boundary dispute which has existed between Portugal and Germany for the past thirty-four years. Secondly, Prof. Schwarz's propaganda in favour of his theories and scheme for recreating the Kalahari lakes and swamps and thereby changing the climate of South Africa, has made many people familiar with the Kunene by name.

The Kunene is an important factor in Prof. Schwarz's projects, and it is unfortunate that he did not possess first-hand or even accurate information about it before formulating his scheme, as many of his vital data concerning this river are erroneous. Prof. Schwarz is not the only one who has gone astray owing to wrong information about this river.

During July and August of 1920 I was in charge of the British Commission which met a Portuguese Commission at the great falls of Rua Cana on the Kunene to negotiate a settlement of the old standing frontier dispute and to delimit the boundary. The British commissioners were, so far as is known, the first Britishers to explore properly the Kunene between Erickson's Drift and the great falls—the most interesting and

important section of the river. It was from the outset apparent that nearly all the information concerning this section of the river, both official and otherwise, was erroneous and wholly misleading. The Portuguese have known this river intimately for a very long time, and the paucity of reliable information regarding so important a geographical feature is surprising.

The time appears now opportune to place on record a few facts relating to the Kunene, and more especially to the short length of about 30 miles in which it makes its first great plunge from the high Southern African tableland down the great coastal escarpment to the Atlantic Ocean.

Before dealing with the particular length of the river in question it is desirable to give some general information about the Kunene and its great sister river the Okavango, as in dealing with any of the diverse problems which may arise concerning the reclamation of the great plains of Ovamboland or the Kalahari, both these rivers must be dealt with.

The drainage areas of the Kunene and the Okavango rivers lie side by side, and the watershed separating them has no very pronounced topographical features. The headwaters of both rivers lie between the 12th and 13th degrees of south latitude, on the crest of the Angola highlands. The watershed between the Kunene and Okavango, flowing south, and the river systems draining north-west to the Atlantic or northwards to the Congo likewise presents no striking features. This watershed is followed very closely by the railway from Lobito Bay to the Katanga area.

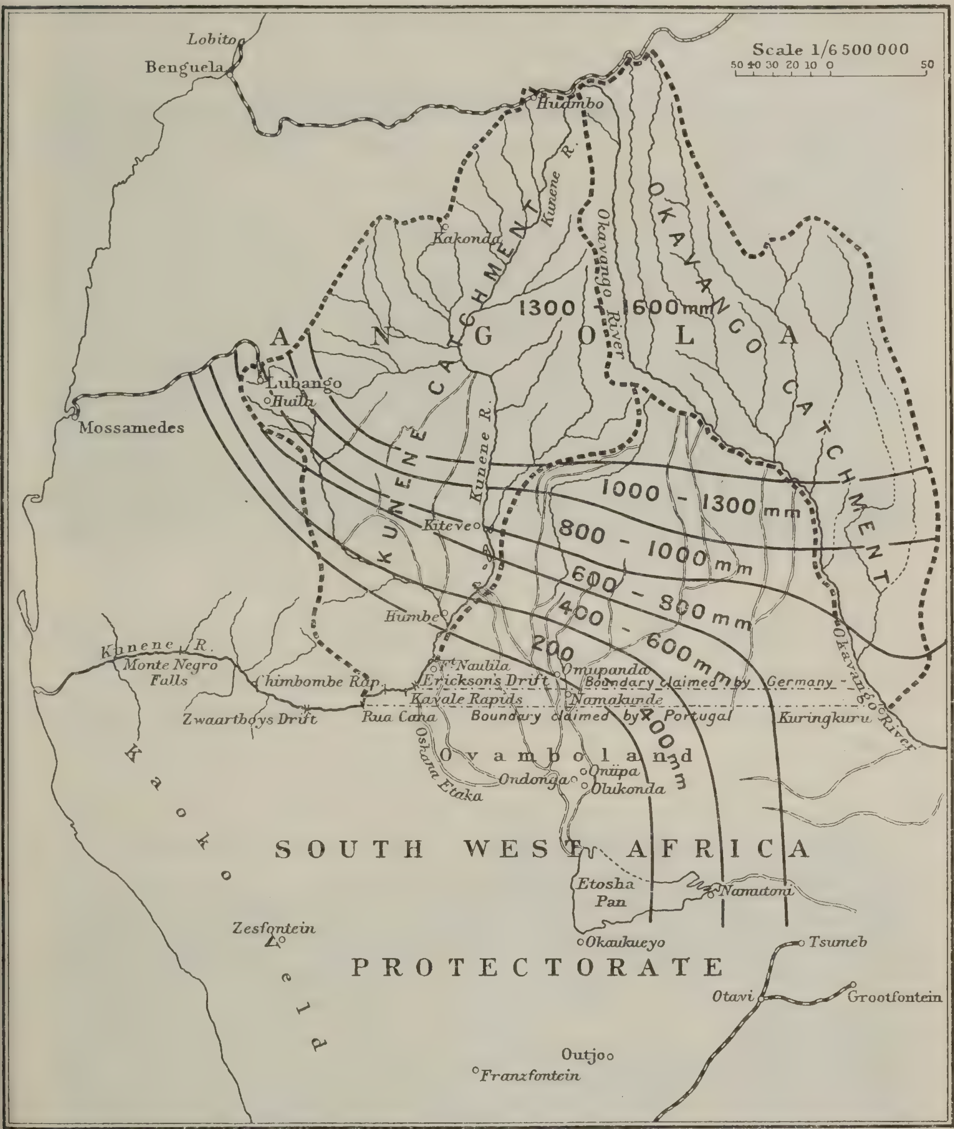
The information given in these notes regarding the catchment areas of the two rivers is based upon the 1917 edition of the 1/2,000,000 Portuguese map of Angola published by the Comissão de Cartografia. This edition is supposed to be entirely new, and in the levels shown there are many differences from the previous edition of 1912. An article in vol. 31 of the *Mitteilungen aus den Deutschen Schutzgebieten* entitled "Studien über Angola" has also been made use of.

The general structure of southern Angola is but little different from that obtaining further south. Along the Atlantic coast there is a belt of arid country varying from 50 to 100 miles. Then comes the great coastal barrier or escarpment, on the top of which is the vast plateau extending east for hundreds of miles with but little variation in level from west to east, but with a very gradual fall to the south from the central watershed.

From levels shown on the map it is possible to plot approximately longitudinal sections of the two rivers. The recorded levels are, however, not bed levels, but refer to spots on or near the banks, such as police or military posts. These are, in many cases, at an appreciable height above the river-bed. Allowing for this, the gradient of the Kunene bed from Kiteve to Erickson's Drift, *i.e.* over a distance of 100 miles, is somewhere between 1/3000 and 1/4000. It is clear, however, that, speaking generally,

the Okavango River has a much flatter gradient than the Kunene and is a much more sluggish river.

Considering the great length of time Angola has been settled, the



Rainfall of Kunene and Okavango Basins

paucity of meteorological data and the short period over which these extend is surprising. The accompanying table of mean annual rainfall in southern Angola and in the territory immediately to the south of it has

been prepared by the Meteorological Department of the Union of S.A. Table No. II. shows the seasonal distribution of rainfall in the Huila district of southern Angola, which is typical of the whole area within the catchments. The only useful information on the subject of rainfall in this country is derived from German sources, and an article on the Meteorology of southern Angola in vol. 30 of the *Mitteilungen a.d. Deutschen Schutzgebieten* has been drawn upon. It will be seen from Table No. II. that there is a pronounced dry season varying from four to six months, between May and October, followed by a wet period. The latter has generally two peaks, one in December and the other in March. During January and February the rainfall is less. The figures in the table, which are calculated only over a very short period of time, do not indicate this as clearly as is said to be the case by reliable Portuguese officers who have been in the country for a long time. From close observation on the Kunene by these officers, it appears that there is a minor flood period in November and December, following the six months' drought, then a lull in January and February; and finally the main flood period during March and April.

For the purpose of calculating the run-off, I have divided the catchments of the two rivers into zones according to the mean rainfall in each. The particulars are given in Table III. It will be seen that the Kunene catchment above the Kavale Rapids, near Erickson's Drift, is about 30 per cent. larger than the Okavango catchment above Kuringkuru, near the border between Angola and the South West-Africa Protectorate. The whole of the Okavango catchment above this point is in regions of good rainfall, whereas about 4000 square miles of the Kunene catchment is in arid or semi-arid country from which the run-off is either nothing or very small.

TABLE I.

RAINFALL IN SOUTHERN ANGOLA AND NORTHERN S.W.A. PROTECTORATE.

Station.	Lat. S.	Long. E.	Average rainfall in millimetres.
Loanda	8° 49′	13° 13′	270
Malange	9° 33′	16° 38′	1240
Kakonda	13° 44′	15° 2′	1534
Villa Bandeira	14° 49′	13° 30′	978
Oniipa	17° 54′	15° 53′	420
Ondonga	17° 58′	15° 50′	412
Olukonda	18° 00′	16° 00′	538
Namutoni	18° 48′	16° 52′	384
Okakweyo	19° 10′	15° 54′	397
Zesfontein	19° 16′	13° 37′	37
Grootfontein	19° 32′	18° 4′	567
Otavi	19° 40′	17° 20′	541
Outjo	20° 6′	16° 6′	423
Franzfontein	20° 12′	15° 00′	225

KUNENE RIVER NEAR ERICKSON'S DRIFT

THE UPPER KAVALE RAPIDS

GORGE BELOW THE UPPER KAVALE RAPIDS

THE WESTERN FALL, RUA CANA

TABLE II.

MEAN MONTHLY RAINFALL IN MM. IN SOUTHERN ANGOLA.

Station.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Sa. da Bandeira *...	95	105	163	157	13	—	—	—	12	46	138	151	880
Huila	101	161	200	67	4	—	—	—	7	33	136	193	902
Omupanda... ...	121	160	80	56	6	1	—	—	11	5	43	141	624
Kakonda † ...	245	408	280	194	25	—	—	—	45	118	192	241	1784

TABLE III.

KUNENE RIVER ABOVE ERICKSON'S DRIFT.

Catchment areas, rainfall and estimated run-off.

Zone.	Rainfall.		Area in sq. miles.	Total rainfall in cub. feet per annum (approx.).	Run-off percentage assumed.	Total run-off in cub. feet per annum (approx.)
	mm.	ins.				
1	1500	59·02	21,830	2993×10^9	10	$299·0 \times 10^9$
2	1150	45·28	2,227	234×10^9	9	$21·0 \times 10^9$
3	900	35·43	2,079	171×10^9	8	$13·5 \times 10^9$
4	700	27·56	1,733	111×10^9	7	$8·0 \times 10^9$
5	500	19·68	2,970	136×10^9	5	$7·0 \times 10^9$
6	300	11·81	2,722	75×10^9	2	$1·5 \times 10^8$
7	100	3·94	1,336	12×10^9	1	—
			34,897	3732×10^9		$350·0 \times 10^9$

TABLE IV.

OKAVANGO RIVER ABOVE KURINGKURU.

Catchment areas, rainfall and estimated run-off.

Zone.	Rainfall.		Area in sq. miles.	Total rainfall in cub. feet per annum (approx.).	Run-off percentage assumed.	Total run-off in cub. feet per annum (approx.).
	mm.	ins.				
1	1500	59·02	21,206	2908×10^9	10	291×10^9
2	1150	45·28	2,208	232×10^9	8	19×10^9
3	900	35·43	2,475	204×10^9	6	12×10^8
4	700	27·56	841	54×10^9	5	3×10^9
			26,730	3398×10^2		325×10^9

* Lubango. † This monthly record is for one year only.

TABLE V.

Estimated Mean Monthly Discharge of the Kunene at the Kavale Rapids.

Month.	Mean discharge in cusecs.	Total approx. volume of discharge in cubic feet.
October	2,000	5×10^9
November	5,000	13×10^9
December	10,000	26×10^9
January	10,000	26×10^9
February	20,000	52×10^9
March	40,000	103×10^9
April	30,000	77×10^9
May	10,000	26×10^9
June	5,000	13×10^9
July	2,000	5×10^9
August	1,000	3×10^9
September	500	1×10^9
	Total	350×10^9

The total amount of rainfall running off these two catchments, measured as stream flow at Erickson's Drift on the Kunene and at Kuringkuru on the Okavango, respectively, is estimated by me to be 350,000 million cubic feet per annum in the Kunene and 325,000 million cubic feet per annum in the Okavango. For each zone I have adopted a different run-off coefficient. These coefficients have been fixed in the light of experience gained in the Union of South Africa from about fifteen years of elaborate study of stream flow in its relation to rainfall, and in my opinion these coefficients are optimistic, especially in the case of the Okavango; though Mr. Karlson, late Hydrographic Surveyor in the Union Irrigation Department, has in a recent publication assumed as much as 20 per cent. run-off in the wettest zone of the Kunene catchment. Now while there is no very large difference in the estimated total annual run-off from the two rivers, the mode of run-off differs enormously. The seasonal variation of the Kunene flow reminds one more of the big South African rivers of the Union, having a very small discharge in the winter and spring months, and a very heavy flood discharge during the rainy season. The Okavango, on the other hand, appears to have a much smaller range, and owing to the shape and flat nature of its catchment and to its generally higher rainfall, a much higher mean discharge is maintained throughout the dry period.

The minimum flow of the Kunene has been studied with some care in recent years by the Portuguese; and during my stay on the river in July 1920 I personally watched the variations of the discharge very closely.

The possibilities of utilizing the power of the great Rua Cana falls has stimulated the Portuguese military engineers to make periodical observations of the dry-weather flow. Between 24 June and 7 July, while I was camped at various points on the banks of the Kunene, the very rapid shrinkage in the discharge was most pronounced and the daily

fall in the water-level was appreciable. On 4 July I computed the discharge to be approximately 1000 cubic feet per second, at a point a short distance above the crest of the great falls. The two Portuguese military engineers on the Boundary Commission, who had considerable knowledge of the river, informed me that at its lowest the discharge would be approximately half this amount, viz. 500 cubic feet per second. From information thus gathered, and having regard to the seasonal distribution of the rainfall, I have attempted to make an estimate of the mean monthly discharge of the Kunene below the Kavale Rapids. This is given in Table V.

From its source, for about 450 miles, the Kunene flows generally due south. It then takes a south-westerly course for the next 100 miles to Erickson's Drift, after which it turns west and continues more or less in this direction to its mouth. Above Erickson's Drift it pursues a somewhat sluggish course down the great alluvial plain of southern Angola, which, in character, is practically the same as the plain of Ovamboland in the South-West Africa Protectorate. On arriving at Erickson's Drift the river has reached the western margin of the great plateau, and about 5 miles further west commences its descent down the 3000-foot escarpment to the coast.

The altitude above sea-level at the crest of the Kavale Rapids is 3215, and the distance thence to the sea is approximately 200 miles. Erickson's Drift is the spot where the famous trader of that name is said to have taken his waggons across the Kunene into Angola. He must have been a very bold man, as it looks a most unattractive spot for such a purpose, and has not since been used. The drift is near the lower extremity of the great bend, where the Kunene changes its course to the west. The gradient is exceedingly flat, the current very small, and the margins are covered with broad belts of high reeds and swamps, which are intersected with deep creeks and pools infested with crocodiles. The great bend of the river is made round a small cluster of kopjes, composed of red sandstones and grits. These kopjes, called by the Ovashimba natives Okarundu, form a striking landmark for miles around. To the east and south of them lies the vast plain of Ovamboland. It is almost dead-flat from east to west, with a very small gradient from north to south. The plain has been formed by the fine silt brought down from the Angola highlands by the Kunene, Okavango, Chobe, and other big rivers. These deposits have in the course of ages gradually filled up the vast depression which stretched across the southern African plateau roughly between 16° and 22° S. lat., and between 15° and 27° E. long. It is possible that at some very remote date all the drainage from the Angola highlands, then much higher, emptied itself into this great depression, but the combined processes of silting and the erosion of the coastal escarpment working eastwards, gradually diverted more and more of the waters of the Kunene catchment to the South Atlantic. In the same way much of the water of

the Okavango, which at one time found its way into the Etosha Pan on the western side of the great depression, has been forced from want of gradient to seek an easier outlet south-eastwards. So far as the Kunene is concerned, it is clear from an examination of that river below Erickson's Drift that the diversion of the water to the west began at a very remote date, and that the full development of the present system occupied an immense period of time. In its present state the Kunene above Erickson's Drift has the same characteristics as other great rivers traversing alluvial plains. In normal cases such rivers gradually build up their beds to higher and higher levels till the gradient becomes too small, and when a particularly large flood overtops the banks it causes the entire river to roll off its old embanked bed and to establish a new course at lower levels in the valley. In course of time such big rivers swing slowly from side to side of their containing valleys and slowly raise the general level of the alluvial deposit. The great rivers of the Punjab and the Mississippi are typical examples of this process. In the case of the Kunene the silting-up process has reached so advanced a stage that the building-up and rolling-off process has long since been impossible. Further building up of the bed would so reduce the gradient and the velocity that the vast volume of water could no longer be transported, and a state of approximate equilibrium has now, more or less, been attained. A sufficient head of water is automatically maintained to create a large enough average velocity of flow during the flood season to keep the main channel free from silt, and enable the enormous mass of water to transport itself. During very high floods such rivers overtop their banks, and in doing so all the heavier particles of silt in suspension are deposited along the margins of the main channel, owing to the immediate reduction in velocity. The margins of these rivers are therefore invariably at a higher level than is the alluvial land some distance away from the main channel. If the bed is free to rise the process goes on indefinitely, and the river runs on the top of an embankment, like the Indus and the Mississippi—both extreme cases. With the Kunene this, for reasons stated, is not possible, with the result that with the bed-levels stationary and the bank-levels rising, overtopping becomes more and more rare. This accounts for the steady diminution in the amount of annual flooding of the Ovamboland plains. It is necessary to insist upon the fact, however, that even were it possible to produce such overtopping on a large scale, the gradient down the plain is now so small that no really large percentage of the flow could be made to pass down southwards to the Etosha Pan. Some enthusiasts, in ignorance of the fundamental laws of hydraulics, think otherwise.

The critical point on the Kunene is the crest of the little rapid about 5 miles below Erickson's Drift. This rock barrier, fortunately a very hard one, regulates the bed-levels for many miles upstream. The great bend of the Kunene between Fort Naulila and Erickson's Drift, a distance

of about 10 miles, formed and still forms one of the main spillways to the south. Numbers of small spill channels from the south bank converge to form one of the largest of the old Oshanas, or shallow flood channels leading southwards towards the Etosha Pan. This particular channel is known as the Oshana Etaka.

A mile below Erickson's Drift the Kunene enters a clearly defined valley. The sides consist of outcrops of red felspathic grits and conglomerates which form very uniform side slopes of about 1 to 1. Outside these outcrops the country consists, for distances up to half a mile, of hard calcareous tufa covered with very dense bush. The surface is generally level, excepting close to the banks, and rises almost imperceptibly to the sandy flats of the plains behind.

In the first 5 miles to the crest of the Kavale Rapids the alluvial floor of the valley is about 10 feet below the surface of the adjoining country. For about half the distance between the drift and the rapids the river is not much broken up into channels, and for a length of about a mile is confined to a single, almost straight, channel from 150 to 200 yards in width. The banks of the main channel are almost vertical and from 8 to 10 feet to low water. The river channels are bordered by belts of high reeds. Between the river and the southern margin of the valley there is an alluvial flat varying in width from 1000 to 2000 feet. This flat is above the ordinary flood-level. It supports patches of scrub and many scattered trees of large size, but the valley presents generally a bare appearance. On the right or Angola bank of the river conditions appear to be similar, but this side was inaccessible to us. About 3 miles below Erickson's Drift the river becomes more broken, and splits up into a number of channels, the network occupying the entire width of the valley. The ground between these channels is lower than it is further upstream, and is more exposed to flooding. A few isolated trees exist, but, in general, all the exposed land is covered with a dense growth of high reeds. Looked at from the margin of the valley, nothing but a vast expanse of reeds is visible.

Near the Kavale Rapids, about 5 miles below the drift, the valley narrows considerably, and the main stream hugs the right bank. Immediately above the rapids there is a large pool bounded on the north by high rocky banks of the valley, and on the south by a large expanse of reeds. The gradient of the river at this point is very small, and where visible presents a peaceful appearance. The Kavale Rapids are formed by a hard barrier of the same red grits and conglomerates as are referred to above, followed at lower levels by the underlying greenish biotite schists. These rapids have assumed considerable political importance, as will be shown later, and have in the past been generally referred to as the "Upper or Small Cataract" in contradistinction to the "Large Cataract," or Rua-Cana Falls, 25 miles downstream.

The Kavale Rapids are in two sections. There is first of all a rapid

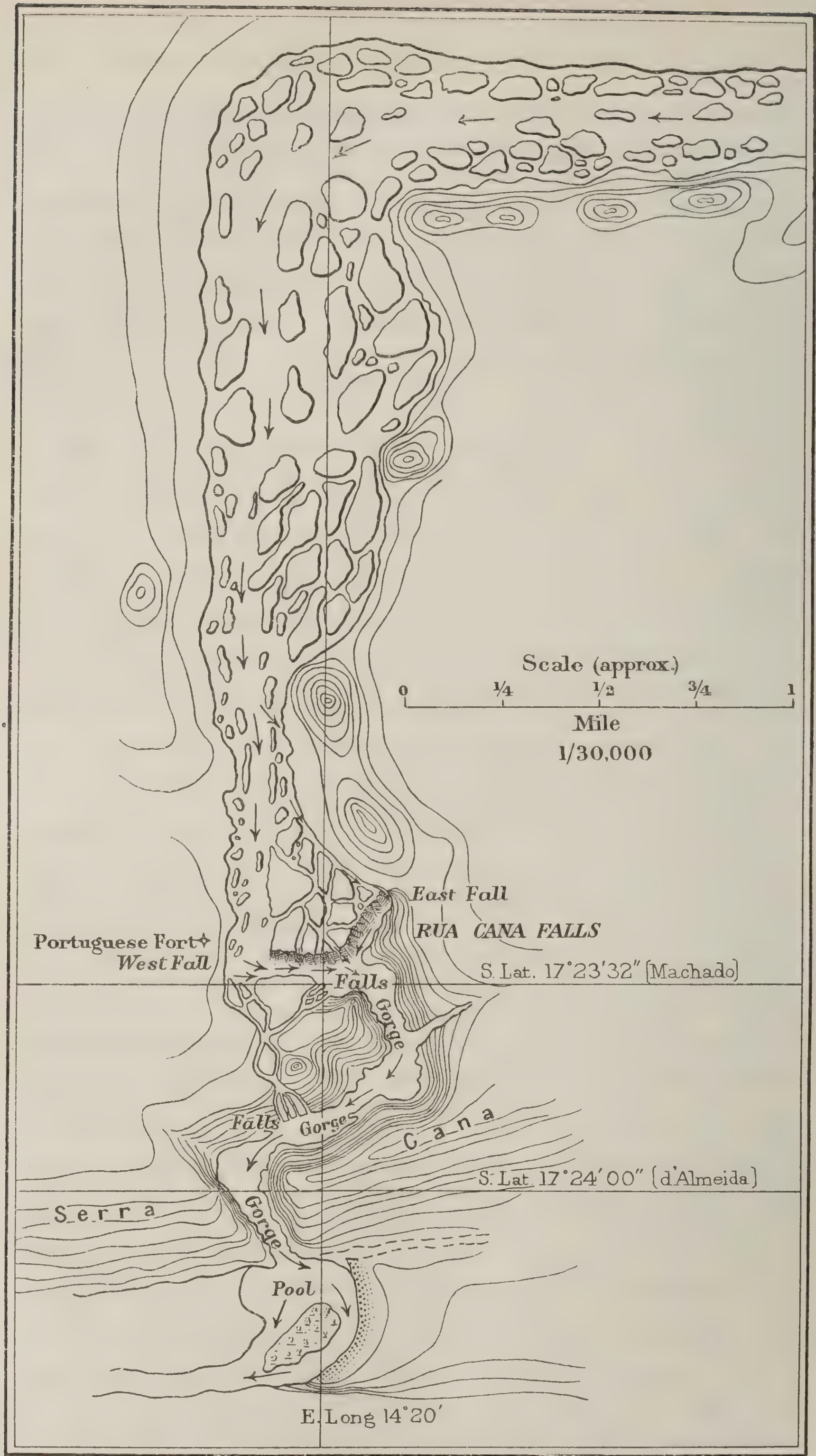
followed by a small fall, the total drop being from 15 to 20 feet. Below the fall the main channel is in a straight narrow gorge, which is, however, of no great depth to the water surface. Below this gorge the river widens considerably, and has a fairly low gradient for a distance of approximately a mile when it reaches the crest of the second and larger fall. There are here several parallel channels. There are two large high-level channels on the left bank separated from the main channel by a long and straight high ridge, composed of schist and various igneous rocks. This ridge is covered with an almost impenetrable jungle, composed mainly of a small species of Euphorbia and masses of the very sharp *Sensivera Cylindrica*, together with many large trees, chiefly Mopani, and a few mighty Baobabs. The main channel below these falls has been cut deep through the red grits into the underlying schists, and the trough of the river now presents the appearance of a deeply cut gorge. The drop at these lower falls is approximately 20 feet. The total drop between the crest of the upper fall and the tail water of the lower fall is, according to levels recently taken by the Portuguese military engineers, 11·82 metres or 38·4 feet. From the edge of the main valley the country, which is covered with dense forest, chiefly Mopani, and is composed of the red grits and conglomerates and calcareous tufa (derived from the former) rises some 50 to 60 feet to the sandy plateau level in 1200 yards. This series of falls and rapids, spread over a distance of a little over a mile, form the "small cataract" of the German-Portuguese boundary dispute, and should be designated by the native name Kavale Rapids or Falls.

Below Kavale the gradient of the river increases, and the valley is cut steadily deeper below the surrounding country of the plateau. Erosion near the valley margins has given the country a hilly appearance for some miles on either side, especially on the south side; and the valley is flanked by a chain of kopjes, mostly densely wooded. About a mile below the Kavale Rapids the valley is from one-half to three-quarters of a mile in width. The higher levels are throughout composed of the red grits and conglomerates, but the lower levels are now wholly composed of greenish or red schists. About 5 miles below the rapids the gradient flattens near the junction of the schists and the underlying granites. A little further down the river is confined to a single channel, which, at the time of my visit (end of July), was about 100 yards wide. The bed consists of shingle, and is smooth and regular. This is the Chimbombe Drift, which forms a very easy crossing at low water. Below this drift the river is flanked on the left by the Okahe hill, the flank of which rises steeply above it. The Kunene now descends through a height of 21 metres or 68 feet at the Chimbombe Rapids which are spread over a distance of several miles, the river throughout being split up into many channels. The river-bed is granite and other igneous rocks.

For the next 12 miles below these rapids the river maintains a westerly course, and is a succession of pools and rapids. At frequent

intervals the valley widens, and there are extensive areas of sandy grass-covered flats which are used as cattle posts by the nomadic Ovashimba tribe of the Kaokoveld, which lies to the south. Between these spots the valley is narrow and very rough, and one is forced to proceed through the dense bush along the southern bank. About 20 miles below the crest of the Kavale Rapids the Kunene makes a sharp turn to the south, and continues in this direction till it has plunged over the great Rua Cana falls, the crest of which is approximately 24 miles below the crest of the Kavale Rapids, or 30 miles below Erickson's Drift. The total drop from the crest of the Kavale Rapids to the crest of the Rua Cana falls is 149·3 metres or 485 feet.

At the level of the crest of the great falls the plateau on the Angola side of the river consists of granites, schists, and quartzites. Approximately along latitude 17° 25′ S. is the junction of these ancient rocks with the felspathic grits, sandstones, conglomerates, and tufas of the Otavi series. It is evident that the Kunene has cut its way along this junction for many miles west of the Rua Cana falls. This big drop is caused by the hard nature of the granites and schists. The valley below the falls along the junction runs due west, is straight and wide, and is flanked by high hills formed by the erosion of the great coastal escarpment. On the north bank the valley is flanked by a straight ridge, approximately 400 feet high, known as the Serra Cana range of hills. This ridge is the remains of the plateau north of the river, and is practically at the same level as the crest of the falls. The original fall must have been over the edge of this great wall. In course of ages it has cut its way back to the north, forming a zigzag gorge 400 feet deep extending to the present crest, which is just over a mile from the end of the gorge measured along the centre line. The crest of the falls is approximately 2300 feet in length, the Kunene approaching it from the north. 2000 feet above the crest the valley is about 1000 feet wide, and is hemmed in by high granite slopes. The main channel, occupied by the river at low water, is in the centre and forms a straight cut through the very rough granite bed, the width varying from 50 to 100 feet. About a mile further upstream the valley opens out, and in the 3 miles of its course, where it makes its big bend to the south, it is over a mile wide and very much cut up into channels, rocky islands, and reed swamps. From the narrow point, 2000 feet above the crest, the valley widens out rapidly and regularly to the crest, forming a kind of delta which is a wilderness of granite intersected by a network of channels. The right or western half of the crest runs due east and west. The left half makes an angle of 120° with the western half and runs north-east to south-west. The main channel hugs the right bank of the valley, but there is an important channel running along the left margin of the delta. Below the crest lies the magnificent gorge, the walls of which are almost vertical. The main gorge starts near the centre of the falls and runs a little east of south for 1300 feet. It then



Gorges of the Kunene and Rua Cana Falls


THE LOWER KAVALE RAPIDS


THE WESTERN GORGE, RUA CANA FALLS

CENTRAL PORTION OF FALLS OF RUA CANA

EXIT OF THE GORGE THROUGH THE SERRA CANA

turns sharp south-west, and continues in this direction for 2750 feet, and then finally turns through another right angle to the south-east, and in this last length of 1500 feet breaks through the Serra Cana barrier into the broad valley below, running west.

Beneath the gigantic wall under the crest of the falls the gorges run towards the centre, from the western extremity eastwards, and from north-east to south-west respectively, uniting somewhat east of the centre and discharging their combined waters into the main gorge above described. During the flood season the waterfall is continuous from one end of the crest to the other. As the discharge greatly decreases during the winter months, the fall is resolved into a large number of individual falls spread about along the face. The main discharge is, at all times, at the western extremity of the western gorge, and the next in importance is at the extreme eastern end of the fall. At extreme low water all the discharge is concentrated over these two falls, but mainly over the western one. The height of the western fall is greater than that of the eastern fall, the gorge being cut much deeper at its upper end than in the eastern gorge. The latter is much rougher, and has a very steep gradient from north-east to south-west. There are a number of minor falls over the precipices of the long north-east by south-west arm of the main gorge, which are fed by channels spilling round the western end of the main fall.

The position of the Rua Cana Falls has been fairly accurately fixed by the Portuguese military engineers and by the German surveyor Schmidt. The centre of the crest as determined by Col. Roma Machado is approximately lat. 17° 23′ S. and long. 14° 20′ E. The crest of the Serra Cana ridge at the point where the Kunene breaks through it was determined by d'Almeida and is on lat. 17° 24′ S. The longitude does not appear to have been determined. The total height of the falls from the crest to the pool below the gorge is 406 feet, the altitudes being approximately as follows: crest level, 2730; pool level, 2324.

Below the falls the south bank of the Kunene is composed of a vertical bluff, some 50 feet in height, of hard calcareous tufa, the valley being here 1500 feet wide. Above this bluff is a limestone terrace 2000 feet wide, which is succeeded by a high escarpment of the red felspathic grits, and above this again there is an immense plateau of hard tufa. The red grits, etc., referred to, which compose all the higher levels on the south bank, are classed as part of the Otavi beds by the German geologists, and are probably portions of the basal beds of the Nama system which lies unconformably upon the schist formation in the region of the Rua Cana Falls. The grits, etc., are of a carmine to purple colour. The fragments consist of quartz and pink felspar up to three-quarters of an inch in length. The felspar is mainly of microline, but some of orthoclase and of plagioclase is also present. The matrix is partly ferruginous and partly siliceous. There is to be seen every stage of change from the unweathered rock to calcareous tufa, with the secondary calcification of the cementing material. The

above is based upon descriptions of hand specimens by Sidney H. Haughton, geologist, on the staff of the S. African Museum at Cape Town.

Of the Kunene below the falls very little is known. Major Manning, Resident Commissioner of Ovamboland, reached Zwaartboys Drift in 1919 from the Kaokoveld and reported the valley as being cut deep in the mountains and very rough and wild. He was, however, unable to spend any time on the river or to make any exploration up or down-stream. At the Monte Negro Falls or Rapids, the Kunene is said to make a drop even greater than at Rua Cana, but the information about these rapids is very vague. The officers of the Portuguese Boundary Commission hoped to explore and survey them during the latter part of 1920. The length of the Kunene described is very wild and unapproachable, and access is only possible along the south bank. The margins are covered with dense forest and are teeming with big game of every description.

Before concluding I will briefly describe the dispute and the difficulties concerning the international boundary. The boundary line between German South-West Africa and Angola was defined in an agreement between the German Imperial Government and the Kingdom of Portugal, which came into force on 30 December 1886. In terms of this treaty the boundary was to follow the course of the Kunene river from its mouth to those waterfalls which are situated south of Humbe, at the point where the Kunene breaks through the Serra Cana. From that point the boundary was to follow the parallel of latitude through it right across to the Okavango river, and thence follow the course of that river as far as Andara, and thence again due east to the Catima Falls on the Zambesi. Whilst the definition given in the treaty is fairly clear, it had been the subject of a dispute between the German and Portuguese Governments until the occupation of German South-West Africa by the British forces in 1915. During 1916 the matter came up for consideration by the British and Portuguese Governments. The dispute has centred round the precise spot through which the parallel of latitude from the Kunene to the Okavango should be drawn. The Portuguese assumed for this purpose the high point on the Serra Cana ridge immediately above the downstream portal of the great gorge below the Rua Cana Falls (lat. 17° 24′ S.). The Germans, on the other hand, made the somewhat ingenious claim that the parallel of latitude must be drawn through the uppermost of the falls below Humbe, viz. the Kavale Rapids, generally known as the "Small Cataract," some 5 miles below Erickson's Drift and 24 miles above the Rua Cana falls. The latitude of the Kavale Rapids is approximately 17° 17′ S. The rival boundaries were thus some miles apart measured from north to south. As the disputed zone, which by the way measures about 300 miles from east to west, is, in its central regions, occupied by large and warlike tribes, the Ovakwanyamas, there has been considerable friction in the past. Since 1916 a provisional agreement has been come to between the local British and Portuguese administrations under which a belt of country

6 miles in width, measured south of the old mission station of Namakunde, is administered, as a neutral zone, jointly by a British and Portuguese resident commissioner. This agreement was fixed up arbitrarily and somewhat regardless of even such data as were available at the time, as the latitude of Namakunde, as determined by the German surveyor Schmidt, shows that place to be 2 km. south of the boundary line as claimed by the Germans. As the zone throughout its great length and breadth is dead flat, excepting in the length along the Kunene west of Erickson's Drift, and is, to a large extent, covered with dense forest, it is obvious that the limits of the zone are very vague, a circumstance which is a constant source of trouble, worry, and irritation to all concerned.

The settlement of the dispute formed the subject of investigation and correspondence between the British and Portuguese Governments in the years following the defeat of the German forces in 1915, and at the end of 1919 each country appointed a commission to meet on the spot and arrive at a settlement of the dispute. The commissions were composed of the following officers:—

Representing the British Government: Francis Edgar Kanthack, C.M.G., Director of Irrigation for the Union of South Africa, Chairman; Herman Eugene Schoch, Surveyor-General, Transvaal; and Major Charles Nicolson Manning, Resident Commissioner, Ovamboland.

Representing the Portuguese Government: Colonel of Engineers Carlos Roma Machado de Faria e Maia, Commissioner; Luiz de Menezes Leal, Captain of Engineers, Captain Jose Luiz Goncalves Canelhas, Assistants.

The two commissions, after making preliminary investigations on their own account, met and commenced negotiations at the Rua Cana Falls on 30 June 1920, and an agreement concerning the delimitation of the international frontier between Southern Angola and the South-West Africa Protectorate was signed at the Portuguese camp adjoining the Rua Cana falls on 6 July 1920. The agreement remains to be ratified by the British and Portuguese Governments, and until this is done no further details can be given.

APPENDIX.

The spelling of place-names demands some explanation. The spellings shown on the maps have in many cases been taken from Portuguese sources, and are often very much mutilated versions of native names. The great difficulty with the lower Kunene region lies in the fact that the country is practically uninhabited and is only visited spasmodically by the nomadic Ovashimba tribes of the Kaokoveld. A large number of these natives accompanied the Commission as porters, and the headman who brought them is an old experienced hunter with great knowledge of the country traversed. The utmost pains were taken to ascertain the recognized names of rivers, rapids, falls, hills, and the like, and these have been adopted, *e.g.* Kavale, Chimbombe, Okahe, Okarundu, Etaka.

The spelling of the name Erickson is that given by the son of the old trader and hunter who travelled extensively in Ovamboland and southern Angola years ago, and whose name figures frequently on maps of these parts. The son, who is personally known to the present British Resident Commissioner for Ovamboland, informed the latter that his father claimed to be British.

The origin of the names Rua Cana and Serra Cana is not known, but is probably a Portuguese corruption of an old native name. The Ovashimba recognize the name Rua Cana, but have probably learnt it from Portuguese sources.

The description of the bluff or escarpment at the great falls as the "Serra" Cana or Cana Range is most misleading, as it is really no range of hills at all. The term was, however, used in the German-Portuguese treaty of 1886 and in all subsequent official correspondence and has therefore been retained. The Germans called the country between the Angola boundary and the Etosha Pan "Amboland," but I think this term is incorrect. It is locally unknown. It is the country inhabited by the very distinct Bantu tribe of the Ovambo, and is known officially, both to the Portuguese and South African Union Governments, as "Ovamboland," and the term Amboland should no longer be used.

INTERNATIONAL AERONAUTICAL MAPS

Lieut.-Col. E. F. W. Lees, D.S.O.

Read at the Meeting of the Society, 17 January 1921. Maps following p. 400.

THE subject of an International Aeronautical Map was first discussed some nine years ago, when, in September 1911, Monsieur Lallemand read before the British Association at Portsmouth a paper entitled "The International Air Map and Aeronautical Marks." His opening sentence was, "The dirigible air balloon, and more especially the aeroplane, which are to-day scarcely out of the period of research and experiment, will soon enter the area of practical politics. It is time that aviators were given means for finding their way similar to those which, for a long time, have existed for navigators and travellers." No definite progress towards the establishment of International Air Maps had, however, been made when the war broke out, and during the war the question was naturally in abeyance; various types of special maps, adapted for the uses of airmen, were published by different nations, but these maps were in no sense international.

Within a year after the armistice, in October 1919, a convention was signed in Paris by some thirty nations and states. This convention laid down the regulations for aerial navigation, and, in an annex, recognized the need for an international series of aeronautical maps, and established certain general principles. These principles embody certain of the proposals which M. Lallemand put forward in 1911.

In this annex it is laid down that there shall be two series of international air maps: one series, to be known as General Aeronautical Maps, is to be on Mercator's Projection, on a scale of 3 cm. to 1 degree

of longitude at the equator, *i.e.* a scale of about 1 : 3,700,000 at the equator, a longitudinal scale of about 1 : 2,000,000 in our latitudes. Certain criticisms have been levelled at the adoption of Mercator's Projection; these will be referred to later.

The second series, to be known as Local Aeronautical Maps, is to consist of degree sheets on a scale of 1 : 200,000; no particular projection is laid down, nor is this necessary. In many countries maps exist already on a scale of 1 : 200,000, and no doubt these maps will be utilized; it must be remembered, however, that in their existing forms they satisfy only imperfectly the needs of the airman.

The annex lays down also:

(i.) that the index scheme for the Aeronautical Maps shall be based on the index scheme for the International 1/Million Map;

(ii.) that the metre shall be the standard of length;

(iii.) that the colours and symbols of the 1/Million series shall be used as far as possible: it will be seen that considerable departures from this proposal are suggested;

(iv.) that, in addition to the customary latitude and longitude notations, the maps shall bear numbers in enclosed rectangles corresponding to a new system of co-ordinate reckoning based on the South Pole and the antimeridian of Greenwich: that is to say, the latitudes commence with the South Pole as zero, and increase northwards to 180° at the North Pole, and the longitude commence with the present 180° as zero and run eastwards round the sphere to 359°. By this system the employment of the letters N. and S. and E. and W. is avoided, and an index number can be given to any sheet based on the co-ordinates of its south-west corner. It should be noted that, under this system of indexing, certain general and local maps will bear the same index number, and that it will therefore be necessary to employ the prefix General or Local when demanding aeronautical maps;

(v.) that each sheet is to be given a suitable geographical name.

The annex finally gives a summary of the details which are to be shown on the sheets of each series, and establishes certain conventional signs. These signs have not in all cases proved entirely satisfactory, and alterations are suggested. Additions have also been made: no symbol, for instance, was laid down for a seaplane station.

The work involved is immense, and a considerable proportion falls on the shoulders of the British Empire. The Air Ministry were faced with the problem of compiling and producing these maps, with no existing machinery. The problem was solved by an arrangement between the War Office and the Air Ministry, whereby the Geographical Section of the General Staff should undertake the work. This arrangement came into force in April last.

The first work undertaken was the preparation of an index scheme for the general maps. At this point the adoption of Mercator's Projection began to come in for some criticism. Mercator's Projection has always been used for navigation on account of the property that the compass course between any two points is the straight line joining them. The drawbacks are the varying scale, the great distortion towards the Poles (so much so that, for maps of the Polar Regions, it will be necessary to employ some other projection), and the considerable additional expenditure in time and labour in production, owing to the necessity for redrawing the map. One proposal, based chiefly upon the large part which radiogoniometry (directional wireless) will play in navigation, was that a gnomonic projection should be employed: the Great Circle Bearings obtained by radiogoniometry can then be plotted as straight lines. The formula for the conversion of the Great Circle Bearing to the Loxodrome is, however, so simple that the proposal, in view of other drawbacks, did not gain adherents. Another proposal was to employ a modified polyconic projection with rectilinear meridians. This would mean economy in time and labour, as the existing Million Series could be used direct: the scale would be the same on all sheets, facilitating the measurement of distances. But navigation on such a projection involves an appreciable change of direction for the aviator at each meridian: this change will be about $\frac{1}{2}°$ to 1° for 1° of longitude. Navigators, however, strongly upheld the proposal to adopt Mercator's Projection for the general maps, and an index was prepared utilizing this projection. The index is based on the index for the International Million Series. Between 60° S. and 60° N. according to the old notation, or between 30° and 150° according to the new notation, each sheet of the General Aeronautical Series will be 18° by 12° and will contain nine sheets of the Million Series: between 150° and 158° each sheet will be 18° by 8° and will contain 6 sheets of the Million Series. The distortion then becomes very great, and it would appear that north of 158° and south of 30° we should adopt some other projection. Though it may be considered advisable to carry the Mercator Series as far north as 162° in order to include Northern Scandinavia, Northern Canada, etc., the General sheets between 158° and 162° would only contain three sheets of the Million Series. The British Empire will be responsible for the production of thirty-six sheets.

One other point arises in connection with this index scheme, and that is the question of overlap. The value of an overlap for aerial navigation is recognized, and a proposal was put forward that there should be an overlap of 3° both in latitude and longitude. This appeared excessive; some sheets would become unwieldy, and the cost of production of a sheet would be considerably increased, and it has now been agreed that an overlap of 1° of latitude and 2° of longitude, wherever the sheet edge is not in the sea, will meet the needs of the airman.

The question of the design of these aeronautical maps was next taken

up. We are on the threshold of a wide development of cartography for aerial purposes, and it appears desirable that we should endeavour to lay down a basic scheme which shall be logical, feasible, and applicable to all aerial maps, the general map, the local map, and any special maps prepared for aerial purposes. The proposals which are about to be submitted to you have met with general approval, except in one or two particulars, in their application to the local maps, but in their application to the general maps considerable differences have arisen, based on the uses to which these general maps are to be put. One point of view is that the general and local maps are entirely different in purpose, the general maps being for navigation, the local maps to enable the aviator to fix his position by comparing the ground beneath him with his map. The other point of view is that the two series are complementary to each other. The depiction of relief is the question chiefly affected, and this difference of opinion will therefore be dealt with in detail when that question is arrived at.

Terrestrial man has, under normal circumstances, a limited view compared with that obtained by the airman, and his gaze is horizontal. A picture will not be of very great assistance; he wants a great deal of information given him in the way of names, etc.; he has milestones, sign-posts, and his own tongue to help him. The aviator is differently situated: he has a large area spread out beneath him, his view is more or less vertically downwards, and he is therefore materially aided by a picture: he does not require much in the way of names, but he does want the characteristic geographical features and all artificial features of special value as guides to stand out clearly. Shape is of special value to the airman: terrestrial man walking along a road, railway, or river which curves about a great deal, does not appreciate the relative values of the curves; the airman does—so much so that he can locate his position by these relative values. Our design must therefore be a logical one, controlled by the values which the aviator places upon the various objects seen from his machine.

The aerial map can scarcely show too much detail, provided there is no suspicion of overcrowding: the limitation of names renders this easier. The exact position and shape of railways, roads, rivers, towns, etc., must be shown as far as the scales employed will allow. On the local maps on a scale of 1 : 200,000 a large amount of detail can be shown, so much so that an airman, who gets in bad weather only a fleeting glimpse of the ground, should be able to locate himself. The scale of the general maps permits only a selection of the detail to be shown, and this selection must depend on the value which the airman places on objects as guides to his position or to course.

The conventional signs must also be based on this value. For instance, among the conventional signs laid down by the Convention is one for telegraph wires consisting of large red crosses; these will stand out in a

most conspicuous manner overshadowing other detail. Whereas in close country the airman will not see the telegraph lines, in open or arid country on a sunny day he may pick up the shadows of the posts, but these shadows will not dominate the landscape. Telegraph lines must be shown, in so far as this is possible without overcrowding the map, as such lines may afford a valuable indication of his whereabouts to the airman, but a conventional sign must be adopted which gives to a telegraph line its correct value from the airman's point of view with reference to the other objects depicted on the map.

Our object must therefore be to obtain a map which shall be clear, which shall be, as far as in our power, a fairly good picture, and which shall give to objects on the ground the value which the aviator places upon them.

For a picture a ground colour is necessary, and it is suggested that a pale green should be used for cultivated ground or ground covered with vegetation, a pale buff for arid ground: in addition to getting a base for the picture, valuable information is provided by this means in many parts of the Empire. To this proposal some objections have been raised. The first is that the ground tint varies according to the season of the year: it is agreed that this seasonal variation is difficult to cater for, but the areas in which a prevalent tint is difficult to arrive at are, taking the world as a whole, limited, and it should be possible to overcome this difficulty. Secondly, that the pencil lines used in plotting a course do not stand out as they would on a white ground: this objection was withdrawn after actually plotting a course on a manuscript map with ground colours. The third objection is that a layer system to indicate relief cannot be employed with a ground tint: this is agreed to, but the employment of a layer system is not advocated.

The maps being primarily aeronautical, we may take it that the provision of aeronautical information in a conspicuous form must be our first care. Black on a map is more conspicuous than any other colour; it is also easier to disassociate black from colours than one colour from another. The aerial information will therefore be in black, and will include the positions of aerodromes, sea-plane stations, and ports of entry, the heights of mountains and passes, the positions of aerial and marine lighthouses, lightships, and wireless stations, and any natural or artificial features which are too small to be represented to scale on the map, but which may be of value to the airman.

Water, always a most useful guide to the airman, will be represented in the conventional blue, in the conventional way, except that swamps, etc., will be shown in blue stipple.

Having decided upon black for all aeronautical information, and blue for all water, the next most conspicuous colour, red, must be used for the objects upon which the airman places the next greatest value. It is considered that railways come next in the airman's picture: in France and

Italy it is said that the roads are of more value than the railways, but taking the world as a whole, this does not apply. Railways are not confusable with other objects, and they are accurately surveyed as regards shape, although their location may be faulty in badly mapped countries : accurate shape, and the accurate plotting of junctions, curves, etc., are invaluable to the airman as guides to his position. Railways go fairly directly from one town to another, having been built to serve the needs of those towns, and the towns they serve are the important towns of a country and therefore normally the objective of the airman both in peace and war : they can be followed both by day and by night in clear weather. In unsettled or sparsely populated countries railways are of the first importance : they afford not only a means of obtaining supplies of petrol, oil, and food, but a probability of obtaining assistance in the event of a forced landing.

Dealing with roads, to the airman roads of any class, first, second, or third, appear much the same. The earth is covered, in highly settled districts, by a reticulation like the workings on a hot-house melon. The main road may be conspicuous by reason of its directness, or as the backbone of a system of roads ; but all roads, when wet, muddy, or tarred, tend to merge into the landscape and lose their individuality : on a railway in use, in fine or wet weather, there is always the shine on the metals. In many parts of the world roads are anything but accurately surveyed.

It is proposed, therefore, to consider the railways as being of more importance to the airman than the roads, and to show them in red : on the general maps by a single red line ; on the local maps a single line of rail will be indicated by one red line, a double line by two red lines, three pairs of rails or more by the two lines blocked in. On the general map it will be possible to show practically all railway lines : if roads are adopted as being of more value to the airman than railways, only some roads and some railways can be shown, and an untrue picture is arrived at. As it is, one detail of the map, railways, is complete : such roads will be shown as the scale permits.

Towns and villages stand out well, and when, as in the local maps, it is possible to show their shape and main arteries, they are most useful guides : it is proposed to indicate them in red. Railways, towns, and villages being indicated in red, it appears sound to propose that all artificial structures, other than those which come under the heading " Aeronautical Information " (lighthouses, lightships, conspicuous guiding marks, etc.), or the heading " Waterways " (canals, etc.) shall be indicated in red : telegraph lines, light railways, tramways, electric power cables, etc., will therefore be shown in this colour.

Roads will be shown in a deep yellow or burnt sienna : if the latter colour is to be used, great care must be taken that it approximates in no way to red.

Woods will be in the conventional colour, green, but not too con-

spicuous a green, as the airman must not rely too much upon the exact outline of woods as an indication to his position. A map cannot be kept sufficiently up to date to show new clearings in, or additions to, woods: a young plantation may be just as conspicuous as a well-established wood.

To sum up, it is proposed to show, on a pale green or pale yellow ground: aeronautical information in black; water in blue; all artificial structures in red, except those which come under the headings "Aeronautical Information" or "Waterways"; roads in deep yellow or burnt sienna; woods in green. Criticism has been levelled at the proposed colours of railways and roads: the counter-proposals are to show the railways in black and the roads in red.

With regard to the railways it is claimed that they are so important to the airman that they should be treated as "aerial information" and indicated in black. None of the aerial information, to be shown on the map, takes the form of a long black line: moreover, black is the conventional colour laid down for the International Million Map. Railways in black have been tried: the result on the map was an immediate loss, in highly civilized countries, of that which we are striving to obtain—absolute clearness for the aeronautical information. As time goes on, there is no doubt that the maps will be heavily loaded with aerial information, especially in the shape of ground marks. At many railway stations the name will be painted on the roof: a railway in black will not show up among these ground marks in black, a railway in red will. It is agreed that the indication of the number of pairs of rails is of value to the airman: if black is employed, a long length of "three or more" pairs of rails will "kill" the neighbouring aerial information, a short length will approximate to the conventional sign for an aerodrome. With regard to the argument that the conventional colour is black, it is agreed that this is so on the majority of maps, but it appears to be most undesirable that we should be bound by convention. Maps exist at present for those who travel on land or sea; now a start is to be made on the maps for those who travel by air, and these maps must be based, not on the conventions, but on the requirements of the airman.

The proposal to show roads in red is based on convention, although, whereas railways are largely shown in black, many instances of roads in colours other than red can be adduced. Again, it is urged that convention should be put aside. It is also argued that roads are just as much artificial structures as railways. This is hardly correct: in very large areas of the Earth roads are artificial only in the sense that man has cleared away the tree-stumps or boulders. There is also this difficulty in connection with the indication of roads in red: it is generally agreed that towns and villages are to be in red, and that the main arteries of a town or village shall be shown. This cannot be done with roads in red: the indication of a village consisting of a single row of houses on either side of the road will be impossible. It has been suggested that this difficulty might be met by

leaving the roads white in the towns and villages, but the result would not be satisfactory in the case of long villages on either side of a road: the effect is that of a road splitting into two and joining up again. Red will give the roads too much importance in the picture, especially as the railways will have lost their distinctiveness owing to their being in the same colour as the aerial information. There are many maps which show the effect of accentuating the roads in red.

It is suggested, therefore, that the depiction of the railways in red and the roads in yellow or burnt sienna will enable us to more nearly satisfy the requirements of the airman than the proposal to show railways in black and roads in red.

There is still one question of great importance to be considered, and that is the question of the indication of the topographical relief. With regard to the Local Maps, there appears to be a general agreement that some form of hill shading shall be employed: this is in accordance with the Convention. With regard to the General Maps, there is no such general agreement: two camps have formed, one advocating the employment of a layer system, involving, of course, no use of ground tints, the other advocating the employment of hill shading with ground tints. Again, the Convention supports hill shading.

The advocates of the layer system put their case thus: the General Map is primarily a map for navigation purposes, the Local Map is a map by which the airman fixes his position by comparing the ground beneath him with his map. The two series are entirely different in purpose, and there is, therefore, no objection to the employment of a different design. While agreeing to a system of hill shading for the Local Maps, they propose a layer system for the General Maps: a layer system, more than any other system, enables a navigator, on plotting his position and finding himself in the neighbourhood of an obstacle, to decide rapidly (and rapidity of decision is essential in view of the great speed at which aircraft travel) whether to cross the obstacle by climbing without the prospect of getting into further trouble on the other side, or to turn to port or starboard with the object of going round it. Moreover, when planning a flight, the navigator can select and plot his proposed course with greater ease on a layered map: a map on these lines will contain little aeronautical detail, and will be used in conjunction with "Instructions to Airmen" and "Lists of lights and ground marks." The layer system proposed is as follows: ground below 1500 feet, in white; then three shades of brown to represent ground below 3000 feet, below 6000 feet, and below 9000: above 9000 feet, white again.

The advocates of hill shading cannot agree that the General and Local Maps differ in purpose: they consider that the two series are complementary to each other, and that the General Map should show as much detail as the scale permits, the Local Map amplifying this detail. The design of both series should therefore be the same.

It has been found by actual drawing that the General Map can be made to give clearly a very large amount of the information required by the airman, provided a system of hill shading is employed. In many parts of the world it will be possible to show all the available detail on the General Map, and therefore on long flights there will be a big saving in the weight of maps to be carried, caused by the fact that, having the General Map, it will not be necessary to carry the Local Map. Again, it will be many years before Local Maps will be available for considerable areas of the Earth's surface: in many instances it will not be worth while producing Local Maps on account of the paucity of detail, and therefore the General Map will be the map which the airman will be compelled to use. The map must therefore be designed for the general purposes of the airman, and not with the primary object of depicting relief.

The tendency will be for the airman to use his General Map in preference to his Local Maps. On the main flying routes he will get to know his route as the motorist knows his road, and the General Map will serve his purpose, if carrying as much detail as the scale permits: if in difficulties he may turn to his Local Map, and he will certainly *not* be assisted by a different design. Moreover, in an aeroplane travelling at a high rate of speed, a change of Local Map might be necessary every seven or eight minutes. The airman will be materially assisted if his General Map is good enough (and it can be made so) to obviate this constant changing of sheets: even if he is flying by local sheets, because he does not know the route and the country is full of detail, or because he is only getting fleeting glimpses of the ground, he will rely on his General Map to take him over the corners of sheets, and he will not want to jump from one design to another.

The airman is committed already to the use of two series of maps: the advocates of the layer system propose that, in addition, books of reference should be employed. In a dirigible there is a table for the maps and a shelf for the books; in an aeroplane there are no such facilities. The maps must carry such information as the characteristics of aerial and marine lights, and the position and nature of wireless stations, ground signs, etc.: books must be consulted before the airman leaves the ground.

Dealing generally with the question of "layers *versus* hill shading," it is claimed that hill shading gives a truer picture of the ground, and that the airman receives material assistance from a picture: the layer system gives an unreal impression of a sudden jump in height from one layer to another. Moreover, a layer system gives too much importance to the relief of the ground; the other detail on the map is overpowered; among the darker shades of brown detail may be obscured. Again, ground covered by wadis or nullahs or cut up by low precipitous hills cannot be indicated by a layer system, and such information is of great value to the airman. No system of relief can give an airman an actual spot to land,

but by hill shading, the areas which offer the best chance of landing can be indicated.

There is also this point to be remembered: in the International 1/Million Series we have, or shall have, maps on which the layer system is employed. In flights involving the crossing of mountainous country, these sheets can be consulted beforehand, and, if necessary, carried: the General Aeronautical Maps will show clearly which sheets of the International Million Series are involved.

With reference to the actual system of layers proposed (white below 1500 feet, shades of brown to denote ground lying below 3000 feet, 6000 feet, and 9000 feet, and then white again above 9000 feet), it is agreed that, on the scale of the General Maps, it is not possible to have the layers at a smaller interval than those proposed, and an indication of change of ground-level limited to 3000 feet is not of real use to the airman. Many important features will not be indicated; for instance, a range of hills running up to 2000 feet above a plateau whose general level is 3500 will not be shown, except by spot heights in black: these spot heights may equally well mean that the ground slopes gradually up to these heights, and the airman will get an erroneous idea of the country. The advocates of the layer system propose to introduce contours or form lines to meet this difficulty. The colour used for these contours or form lines will have to be deeper than the deepest shade of tint to be employed, and the map becomes still more overloaded with the depiction of relief to the exclusion of other detail. Contours in any case will not be of assistance. They cannot be interpolated at a small-enough interval to show any detail of the ground. How the ground above 9000 feet is to be dealt with has not been stated. Hill shading has been suggested, but if it is agreed to use hill shading for these areas, which would appear to be most important in view of the heights at which aeroplanes fly, why not use hill shading for the whole map?

The balance of the argument appears to be in favour of the advocates of hill shading, who wish for similarity of design in the two series, and who do not think that the layer system proposed will give a sufficiently good indication of the ground. There is still the question of the actual navigation of aircraft. It is claimed that this is easier on a layer system than on any other, but hill shading and spot heights would appear to suit the aerial navigator equally well. By hill shading mountain masses and difficult country can be clearly shown, and avoided if necessary; otherwise the spot heights will give the airman the information he requires. In fog, in bad weather, or at night he will climb well above any spot height in the neighbourhood of his estimated position. If he has to come down under these circumstances, he will take to his local map (which is hill shaded) in the hope of picking up some little bit of detail as a guide to his position.

The three controversial points in connection with the Aeronautical Maps are therefore:

(1) Whether Mercator's Projection is the most suitable projection for the General Maps.

(2) Whether hill shading with ground tints or a layer system shall be employed on the General Maps for the depiction of relief.

(3) Whether railways shall be shown in red and the roads in burnt sienna, or the railways in black and the roads in red.

Except on these points, the proposals which have been put forward have met with fairly general approval; it is, however, worth while running through the conventional signs in detail: there are points which require explanation, and certain signs have not so far been referred to.

As already stated, *forests and woods* will be shown in green; orchards will be indicated by green dots in regular lines where the scale permits; with regard to country covered by small orchards, vineyards, hop-fields, banana plantations, etc., the airman not only may get an idea of his whereabouts from their indication on the map, but he must also be warned off them. It is suggested that this information can be most suitably conveyed by lettering on the serial information plate. A mangrove swamp will be a green stipple on a blue ground.

The indication of *water* requires no comment; the use of a blue stipple for swamps, etc., has been referred to; areas liable to inundation will be shown by a blue stipple to warn airmen off them; when such areas afford good landing grounds at certain times of the year, a note will be made in black on the serial information plate.

Railways have already been discussed. A *light railway* will be shown as a single red line with the letter L in black; a *tramway* in the same way with the letter T in black; when the light railway or the tramway runs along a road, the black letters only will appear: in both cases departures from the road must be clearly shown. It is not proposed to distinguish overhead electric railways and tramways; an airman, in the event of a forced landing, will endeavour to keep clear of anything red as long as he is in a position to use his map; then he uses his eyes *Railways under construction* will be shown by dotted red lines.

Overhead power lines will be indicated by the symbol for telegraph lines with the addition of the letter P in black.

With regard to *roads*, in the Convention it was laid down that a distinction should be made between "very visible" and "less visible" roads; this proved to be unworkable, and no attempt has been made to apply this distinction. *Tracks* will be dotted.

Sandy desert and *sandbanks* will be indicated by a brown stipple; sandbanks are shown up well by this arrangement. The 10-*metre bathymetrical line* will be shown in blue, where the indication will be of value to the airman.

With regard to the *lettering*, other than Aerial information, this will be in black, in a different style to that employed for the Aerial information, and will be very limited.

With reference to the Conventional Signs for Aerial Information:—

Aerodromes and Emergency Landing Grounds.—The true shape and orientation will be shown; when this is not known, they will be shown as circular. No sign was laid down for a *Seaplane Station* in the Convention; the one shown is suggested, and combines well with other aerial information.

Wireless Telegraph Stations.—It is suggested that, when small and isolated, this symbol may bear a resemblance to a square; and a proposal is under consideration to use three arms at an angle of 120°. The method of distinguishing between the different forms of wireless and directional wireless has yet to be decided. The International Hydrographic Conference has adopted symbols for five different kinds of stations, but there are more than five to be provided for, and the symbols adopted are not altogether suitable for our purpose.

Aerial Lights.—When the light is at an aerodrome, the circle will circumscribe the aerodrome.

Marine Lighthouse.—This is one of the Admiralty symbols, except that the star is five-pointed instead of six-pointed. The sign for two or more lights in close proximity, such as harbour lights, is a new proposal; such lights are often a useful guide to the airmen, and the stars were found to take up too much room.

Light Vessels and Light Buoys.—There has been a great deal of discussion over these symbols; it seems desirable that the decisions of the International Hydrographic Conference should be adhered to, and the British Admiralty signs (a boat in elevation and a buoy in elevation) adopted. These signs are, however, unwieldy and take up too much room; in well-lighted waters the configuration of lights is not immediately or easily grasped; they are in elevation, and the airman sees objects in plan. The actual position of the light is indicated by a small circle on the water-line of the symbol, whereas the eye is caught by the star, representing a light, which appears at the top of each symbol. In crowded waters there are difficulties in showing the characteristics of the lights. The symbols shown are therefore proposed, and a comparison of two maps, one employing the Admiralty symbols, the other employing the proposed symbols, has resulted in favour of the proposed symbols. Light-buoys will not usually be shown, as they resemble closely the lights of fishing-vessels, but there are places, especially abroad, in which the indication of a light-buoy may be of value to the airman.

International Boundaries have been treated as aeronautical information; they involve customs, and are the boundaries of potential prohibited areas. The symbol suggested is more easily handled on a complicated winding boundary than that laid down for the International Million Series.

Heights.—The Convention proposed that the figures indicating heights should be surrounded by an oval ring; this was unsatisfactory, owing to possible confusion with ground marks. Now it is proposed that a black

triangle and dot should be used; but this is the symbol for trigonometrical heights; the heights on the aeronautical maps are shown only to the nearest 100 metres above the actual height. A dot with a number on either side stands out sufficiently well, and we do not run into double figures on the left-hand side of the dot. It has been suggested that a cypher should be shown on the left of the dot when the height is under 1000 metres, but the single number shows clearly the ground under 1000 metres, and this indication may be of value to the airman.

Aerial Corridor, or port of Entry. This symbol is not altogether satisfactory; it will be difficult to use on the general map when the aerial corridor is narrow or when aeroplanes are ordered to cross a boundary at a certain town or aerodrome. We may get a black mark looking at first sight like an aerodrome; two half-arrows, which can be combined into one arrow if necessary, would meet the case better.

Symbols in combination.—So much of the aeronautical information comes all in one place that this fact was one of the controlling factors in designing the symbols. It will be seen that they combine fairly well.

Isolated or Conspicuous Features call for no comment. It is intended that these features shall be indicated only when they are isolated or predominate over other features in the landscape to such an extent as to form valuable guides to the airmen. A gasometer in England, for instance, will not be of much value; most towns have them. On the other hand, such a feature as the Dashwood Memorial in Buckinghamshire might be a valuable guide to an airman's whereabouts.

Abbreviations for Descriptions of Lights.—The airmen must be saved any necessity for consulting books, and the characteristics of marine and aerial lights must therefore appear on the maps. An international scheme has been worked out, and applied to some hundreds of lights with success. Some examples are shown.

Finally, it is necessary to say that the very considerable expense of producing maps on the lines of these proposals is recognized, and no doubt it will only be possible to build up these maps gradually to their final form, producing meanwhile provisional series in, say, three colours, to give the airman some means of finding his way about. But it does seem to be most desirable that we should endeavour to establish a detailed scheme at the very start, in order that there may be no haphazard adoption of colours and symbols as the work progresses.

Before the paper the PRESIDENT said: I have much pleasure in introducing to you Colonel Lees of the Geographical Section, G.S., who is responsible for the construction of the maps for Air Services, and especially for the International Aeronautical Map now under consideration.

Colonel Lees then read the paper printed above, and a discussion followed.

Colonel E. M. JACK: I have one or two small remarks to make upon Colonel Lees' paper. I should like to repeat his emphasis on the fact that any

opinions offered are quite personal and unofficial. I think that the question may be asked why so many proposals contrary to the arrangements of the Convention of 1919 are being put forward by us. The fact is, the British have done more work in preparing these maps and getting out the scheme than anybody else, and we have come up against all kinds of practical difficulties in applying rules laid down by the Convention, and that is the justification for the various proposals for change which we have put forward. The Convention should have laid down principles and not dealt with details at all. As a matter of fact, they did go into detail in several respects, and the details that they laid down have been found in many cases rather difficult to apply. As to the points raised in the paper, I should first like to remark that the decision arrived at by the Convention to introduce a new system of co-ordinate reckoning is, in my opinion, an unfortunate decision and one which is likely to produce a great deal of confusion. We shall always have to say, if we use that system, whether we are using the new or the old. The old system of latitude north and south of the Equator (that is the system based on the Equator and the meridian of Greenwich) is sanctioned by very long usage, and it is quite adequate, I think, and perfectly sound. I cannot see that any practical purpose is served by this proposed new method of reckoning. It may appeal to the theorist, but I cannot see that there is any practical good in it. With regard to Mercator's projection, it was of course evidently decided on in accordance with the views of navigators. There are certain disadvantages, one admits, in Mercator's projection, but it must have very solid advantages to navigators to have lasted for so long a time. It cannot be due entirely to conservatism that it has been used for all these years, and it seems to me that, although there are admittedly certain disadvantages, it is perfectly sound to adopt it. The disadvantage that it is inapplicable beyond a certain point north and south of the equator does not seem to me very weighty, because flying in the Polar regions is not likely to be very common. The chief disadvantages are the expense and labour of having to re-draw so many maps. The question of the system of relief is the most important of the debateable points. It is rather unfortunate that airmen seem to be divided in their opinion on this subject. It is not a question of nationality at all, because you have advocates of both systems on either side of the Channel, but as a matter of fact I think I am right in saying the majority of our airmen advocate the hill shading, and the majority of foreign airmen the layer system. I do not know whether I am biassed on the question. I came to the Geographical Section recently after this matter had been discussed a great deal, and it seems to me that the arguments advanced in favour of the hill shading are very sound. It seems beyond question that what the airman wants is as good a picture of the ground as possible, and I do not think for the particular purpose of the airman that the layer system can give the same picture as the method of hill shading. Of course many points come up in connection with this question, but perhaps the most important is that question of showing hill features in the large intervals which occur between one layer and another. As Colonel Lees showed, the intervals between the layers on these small-scale maps must be 3000 feet, and the fact that this cannot be shown satisfactorily on a layer system seems to me a very strong argument. It would be interesting if any Air Officer here would give his views about that. It seems to me that is a very strong argument in favour of the hill-shading method. As to railways and roads, there again I think the reasons put forward for the colours we propose are sound, but I do not think it is anything like so important as the question of relief, and personally I should be inclined to compromise on that question if by

so doing we could get the hill features shown in the way we think best. I should be quite prepared to agree to showing the railways in black and the roads in red, which I think is what the French in particular want, and it has occurred to me the following solution might be found. Colonel Lees explained to us that the most important thing in the air map is the aerial information, and for that the most conspicuous colour, black, was chosen; while red, the next most prominent colour, was taken for other artificial information. But red, though less strong than black, is a most conspicuous colour, and if we were to reverse the system and use red for aerial information and black for other artificial features, we should preserve the clarity of the map, and at the same time conform more to the Convention and also meet the objections of the French and other people who are very anxious to have railways in black and roads particularly in red.

The FRENCH AIR ATTACHÉ: Colonel Lees has explained very clearly the different points of view. I must say we perfectly agree in the question of the local maps; and even in the question of the railways in red and the roads in black we are not so obdurate as we are supposed to be, because I have reason to believe that we propose to go half way and accept the British system on that special point. It is all due to the difference in the French roads, which are more conspicuous, because we have long stretches of straight lines, which do not, or seldom, exist in England, so that the roads in France are very good landmarks and in any case much better than here. But anyhow, I think the whole question of the local maps is one on which we are ready to come to an agreement. The question of the layer or hill-shading system is different, being one of principle: I mean that the adoption of one or the other depends on the use of the map itself. For local maps which are to be used in direct comparison with the land, the hill-shading system seems to me to be obviously the better; but for general maps, and this is the point, we do not think that they must be a picture of the ground; they are intended, as we think, purely for navigating. In consequence one must be able to put bearings on this map, and we further think (reserving the question of unknown countries) that we shall never use in our countries the general map for a direct comparison with the ground. As I said before, the general map seems rather to be used for preparing a voyage or for putting position lines or any geometrical information on it (azimuths, bearings, etc.). According as this point of view is adopted or not, so the question of hill shading or layer colouring bears relation to it, the latter system being less picturesque and descriptive, but much more accurate for the correct preparation of an aerial journey and the laying out of a safe course. I do not pretend to say which is right or wrong, I have simply tried to express in a few words the real reason for a difference of opinion which does not arise from an "æsthetic fancy" but from a basic difference in principle on the use of the maps themselves.

Colonel H. ST. L. WINTERBOTHAM: Colonel Lees mentioned that there were three points remaining open for discussion—the question of the colours of railways and roads, layers *versus* hill shading, and the choice of a projection. In the question of the colour of railways and roads, I should think most people would agree that previous convention must go for nothing in comparison with the needs of the airmen, and the arguments given for the red colouring of railways seem to me convincing. Whilst we are on this question it may be of interest that the airmen in France were very keen on showing long straight avenue roads, with a line of trees on each side, as a long wood, by adding two green strips along the margins or by colouring the whole thing in a green band.

Long straight avenue roads would also be met with in parts of Italy, Germany, and elsewhere. As to the question of hill shading *versus* layers, the arguments for hill shading were very ably put, but I do not think the cartographer will agree when Colonel Lees says there would be difficulty in making three layers so transparent as not to interfere with the detail. The layer system as proposed is an extremely simple one, and the heaviest tint of browns should be comparatively light, so that there should not be trouble in making it transparent. I think, however, that the map lover, in listening to this lecture, would approve of the solutions advocated except in the third question, the choice of a projection. The selection of Mercator's comes as something of a shock. Colonel Lees said that the great advantage of it was that upon it the compass course between any two points is the straight line joining them. That is not strictly true. Unless one is equipped with a gyroscopic compass it cannot be true. Here, for example, is a picture of a typical sheet as it would cover a piece of northern Asia. The isogonals are truly perplexing-looking things upon it. The magnetic meridians would not be so complicated. But in this particular sheet the magnetic meridians will converge to some point above the centre of the map. Having no knowledge of navigation I make no pretensions to knowing the ways in which sailors set their courses, but to claim that Mercator's projection is absolutely necessary for the purpose seems to me to want a little amplification. No doubt there are tables in which one may find the corrections to the magnetic bearing at any spot. I am not quite sure why such information should not be tabulated for a more reasonable projection. With regard to the question of the size of sheets, I have no time to go deeply into the subject. It will have to suffice to point out that the area of the sheet at latitude 60 is 1·7 times that of a sheet at the Equator. This difference of size is a measure of the distortion which Mercator's projection must introduce. No doubt the choice of a projection must rest to a large extent with the air navigators themselves, but one cannot but feel that navigation for aircraft may not be entirely the same thing as for seacraft. I take it that the sailor travels generally between ports of call not very far distant one from the other, and that aircraft routes of the future may include very long non-stop flights. In that case, his best course would not be a loxodrome, but a great circle. If then the great circle is equally or more important than the loxodrome, wherein lies the advantage of Mercator? I think Colonel Lees said that the calculation of the great circle on Mercator was facilitated by tables. Apparently then the advantages of Mercator's projection consist largely in the tables which have been prepared for use with it. As I said before, however, if tables may be prepared for one projection why not for another?

Colonel J. Waley Cohen: I think there is very little to be added to what Colonel Lees has said from the point of view of the Controller of Civil Aviation. After having talked to the pilots when planning the long-distance flights which were carried out last year, both to Australia and to the Cape, the Navigation Department of the Air Ministry inclines for the sake of uniformity (especially as the general map is used in long flights more than the local map) to support the views put forward by Colonel Lees, that the "shading" for all maps is likely to prove the most useful. With regard to the colours for roads and railways, I have not the least doubt that it will be possible to bring into line the slight difference of opinion held in the various countries taking part in the Air Navigation Conference. There is one difficulty one comes across in talking to English pilots, and that is, we do not know in this country what a road means to the mind of our Continental friends, as we have few big

straight main thoroughfares such as theirs, which characterize the Continent. But these maps are intended to be international in the widest sense and to cover the whole World, and therefore one has also to realize that in large parts of the World no road recognizable from the air, or even on the ground, exists at all, whereas the railway can always be distinguished. I understand that some of the pilots who did the Australian and Cape flights found that a road is practically useless as any sort of guide, because in the wild country that they went over even such roads as existed hardly showed up at all.

Captain LLOYD: There are only two points which occur to me after hearing Colonel Lees' paper, and they are both details. The first is with regard to the depiction of the towns. In the slide shown we saw the towns depicted—houses as little circles dotted along the roads and main arteries. I should like to suggest that the towns should be shown more solid and that the main features for the towns should be exaggerated rather than shown truly to scale. I know the objection that exists in the minds of all map-makers to the departure from the true scale from anything, but I should like to suggest that the main features of the town design should be exaggerated within the limits of the towns themselves, also anything in the way of parks or water, and that the rest of the towns be blocked in or closely shaded to make these particular points stand out more forcibly. Another point that occurred to me was the question of the description of the lighthouses. Of course the question of their description is very essential and important, but if you get round a harbour several lighthouses, each combining all the eight different letters given at the bottom of the chart, I am afraid it is going to be a very difficult question to get these plainly printed especially when you are dealing with the smaller-scale maps. Colonel Winterbotham has already introduced the point of tree-bordered roads—one which was brought very prominently to my notice by airmen during the war.

Mr. A. R. HINKS: I should like especially to emphasize what Colonel Winterbotham has said in criticizing quite seriously and rather strongly the adoption of Mercator's projection for this general flying map on the scale of half a millimetre to the minute of arc or three centimetres to the degree on the Equator. It does not appear to me that the choice of Mercator's projection is well founded. Navigation of aircraft has some analogy to navigation at sea, but the considerable differences may make such an analogy very misleading, owing, in the first place, to aircraft being very much faster than anything at sea; secondly, because of the necessity of having a map which has to bear some relation to things on the ground; and thirdly, for the necessity of a close relation between the small and the larger scale maps. There is nothing at all analogous to that last in navigation. Navigational charts are on all sorts of different scales. That, I think, is a very important difference. The sole merit of Mercator's projection at sea has been clearly stated by Colonel Winterbotham: the line of equal bearing—the rhumb line—is a straight line, and since the meridians are all straight lines parallel to one another, it is possible to take off the bearing of your loxodrome with the aid of the familiar parallel ruler, which is run over the chart to the compass rose. I think it is the convenience of having a parallel ruler and a compass rose that makes the sailor so keen on Mercator's projection. Now the full simplicity of that method is available only on short courses, over which the magnetic variation is constant, and then the course must be continually checked for the effects of changes in variation of the magnetism in the ship. The variation of the scale of the Mercator chart at sea does not matter very much to the sailor because he goes so relatively slow. In aircraft the case is quite different. The speed is so great and the

BRITISH PROPOSALS FOR
INTERNATIONAL AERONAUTICAL MAPS OF THE WORLD.
CONVENTIONAL SIGNS FOR THE BASIC MAPS.

	General Map	Local Map
Open Water		

NOTES.

Water which appears as more than 0·5 mm. will be shown as 'open' water—dark blue outline and light blue tint. Where of limited extent, the light blue plate may be omitted and graduated lines used thus.—

Where an ocean-bed contour is of value to the airman it is shown by a dotted blue line, the depth, in metres indicated by such an isobath being given in black.

The 'lighting' of relief is uniformly from the north-west.

Where light railways or tramways are shown, the railway symbol is used with the addition of the letter **L** or **T** in black. In closely settled areas tramways will be generally omitted. Where light railways or tramways run along roads, except in closely settled areas, the letter **L** or **T**, in black, will be given but the railway symbol omitted.

Overhead power lines are distinguished from telegraph lines etc. by addition of the letter **P** in black.

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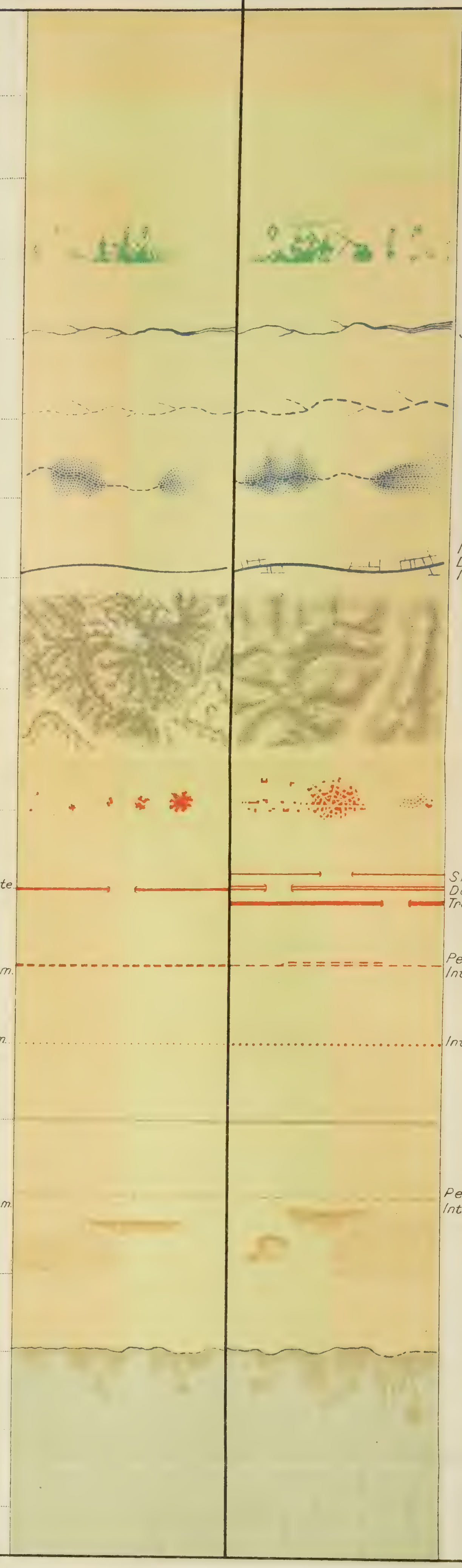
INTERNATIONAL AERONAUTICAL MAPS OF THE WORLD.

CONVENTIONAL SIGNS FOR THE BASIC MAPS.

			General Map	Local Map
Ground	Sterile			
	with Vegetation			
Woods, Orchards, Vineyards, &c.				
Water Outline	Rivers, perennial			See footnote
	Rivers, non-perennial			
	Marsh and areas of Inundation			
	Canals			Navigation Drainage Irrigation
Relief	Elevations, perennial Snow, Glacier, Depressions, (Ravine, Wadi, &c.)			
Artificial Structures	Towns, Buildings, &c.			
	Railways (and Tunnels)	See footnote		Single Double Treble or more
	Railways disused or under construction	Peck 1 mm Interval 0·5 mm.		Peck 1·2 mm. Interval 0·8 mm.
	Overhead power lines, Telegraphs, &c.	Interval 1 mm.		Interval 1 mm.
Roads	Well defined			
	Tracks	Peck 1 mm Interval 0·5 mm.		Peck 1·2 mm. Interval 0·8 mm.
Sandy Desert and drifted sand, Cliff, Rock and Quarry				
Coast Line (Mean High Water Spring Tides), doubtful (broken line)				
Banks, Rocks between high and low tide				
Open Water				



NOTES.

Water which appears as more than 0·5 mm. will be shown as 'open' water — dark blue outline and light blue tint. Where of limited extent, the light blue plate may be omitted and graduated lines used thus.—

Where an ocean-bed contour is of value to the airman it is shown by a dotted blue line, the depth, in metres indicated by such an isobath being given in black.

The 'lighting' of relief is uniformly from the north-west.

Where light railways or tramways are shown, the railway symbol is used with the addition of the letter L or T in black. In closely settled areas tramways will be generally omitted. Where light railways or tramways run along roads, except in closely settled areas, the letter L or T, in black, will be given but the railway symbol omitted.

Overhead power lines are distinguished from telegraph lines etc. by addition of the letter P in black.

International Air Maps.
LEES.

T = *Tem*

A = *Alte*

F = *Fixe*

G = *Gro*

E = *Flas*

C = *Occ*

R = *Rev*

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INTERNATIONAL AERONAUTICAL MAPS OF THE WORLD

CONVENTIONAL SIGNS FOR AERIAL INFORMATION (BLACK) PLATES.

Plate I.

	SYMBOL	NORMAL SIZE IN MILLIMETRES	
		GENERAL MAP	LOCAL MAP
Aerodrome (See notes I&II)		True outline and orientation 2	To scale
Emergency Landing Ground (See note I)		True Outline 2; when a circle 1·5 (see note)	To scale When a circle 2·5
Seaplane Station		Three circles 4 (broken over land)	Four circles 5 (broken over land)
Wireless Telegraph Station, with Radio Goniometer, with Radio Telephony	R R R G	Cross 2. H^{t} of letters ·8	Cross 2. H^{t} of letters ·8
Meteorological Station in conjunction with a wireless telegraph station	R M	"	"
Mooring-mast not at a landing-ground (See note II)		Circle 1·2	Circle 1·8
Name of Aerodrome, Seaplane Station, &c.	FELTHAM	Height of letters 1·2	Height of letters 1·5
Aerial Ground Signs showing form of sign (See note VI)	REDHILL 6 9⊔2	Height of letters 1·1	Height of letters 1·1
" " " form not shown		1×2	1×2
Prohibited Area, small: large		Dots 0·5 apart, lines 1 apart Width of ruling 2.	Dots 0·5 apart, lines 1 apart Width of ruling 2.
Aerial Lights		Inner Circle 2 Outer Circle 2·4	Inner Circle 3 Outer Circle 3·5
Marine Lighthouse; 2 or more Lights in close proximity, e.g. harbour lights		Inner Circle ·8 Outer Circle 1·7	Inner Circle ·8 Outer Circle 1·7
Light Vessel; Light Buoy		Inner Circle ·8 Outer Circle 1·7; ·9	Inner Circle ·8 Outer Circle 1·7; ·9
International Boundary		Cross 1, interval 1.	Cross 1. interval 1.
Line of Equal Magnetic Declination	——5°W——	Peck 2, interval 1. Height of letter 1·2	See magnetic symbol on Plate 3
Heights, in thousands of metres to one place of decimal, the decimal point indicating the position	5·8 2·0 ·4	H^{t} of figures 1·1	H^{t} of figures 1·1
Wells, permanent; temporary (See note III)		Semicircle 1·5	Semicircle 1·5
Aerial Corridor	CORRIDOR	Height of letters ·8	Height of letters 1

	SYMBOL	NORMAL SIZE IN MILLIMETRES	
		GENERAL MAP	LOCAL MAP
ISOLATED OR CONSPICUOUS FEATURES (See notes IV & V)			
Fort		1·4	1·5
Castle, Mansion		1×·6	1·1×·8
Ruin		1×9	1·2×1
Factory Chimney		·6	·8
Spire or Steeple, Belfry, Tower, Pagoda, Minaret &c.		1	1·2
Gasometer		·8	1
Cemetery		1×·8	1·2×1
Quarry, Mine, open to the sky		1·4	1·6
Windmill		·6	·8
Monument, Pillar, Cairn		·9	1
Bridge, Viaduct		8	1
Lock; Dam or Weir, (on river or canal)		·8	1·1
Building		·8×·5	1·1×·5
Prominent Tree or clump of trees; Rock		9	1·1

SYMBOLS IN COMBINATION

Aerodrome with Wireless Tel. Station	BATH
Aerodrome, Seaplane Sta. & Wireless Tel Sta.	HULL
Aerodrome, Seaplane Sta. Wireless Tel Sta. Radio Goniometer, Radio Telephony, Meteorological Station, Aerial Light & Aerial Ground Sign.	BREST
Aerodrome with Aerial Light	WELLS

NOTES

I Where the true outline of Landing-grounds (Aerodromes and Emergency Landing-grounds) is not known, it is shown as circular.

II The facilities for aircraft at aerodromes are shown by letters, in sloping Egyptian Capitals, under the name of the aerodrome, as follows.

- A = Hangars for aeroplanes
- H = Hangars for dirigibles
- F = Balloon inflation plant
- D = Customs
- P = Mooring-mast for dirigibles

III Wells are only shown where of especial importance in arid regions

IV Conspicious features are only shown where they are isolated or dominate over other features of a like nature

V Conspicious features not included in the above list may be shown as they occur, together with their descriptions thus:— RUINED AQUEDUCT MINE DUMP

VI Where at a landing-ground the form of the aerial ground sign is the name of the station written in full, the symbol for a ground-sign is not employed

Plate II.

ABBREVIATIONS USED IN DESCRIPTIONS OF LIGHTS

CHARACTER OF LIGHT

T = Temporary or Seasonal. Lights which are not permanently in operation.

A = Alternating. Lights which change colour.

F = Fixed. A continuous steady light.

G = Group. Used in conjunction with "E" or "C" to indicate a group of two or more flashes or eclipses occurring at regular intervals.

E = Flashing. An intermittent light where the total duration of light is less than that of darkness.

C = Occulting. An intermittent light where the total duration of light is equal to or more than that of darkness.

R = Revolving. A light gradually increasing to full brilliancy and then decreasing to eclipse.

NATURE OF LIGHT

- e = electric
- w = white
- r = red
- v = green
- b = blue
- p = purple or violet
- m = masked
- i (used after "e", "w", "r", "v", "b" or "p" = a flash of greater intensity.

THE ABBREVIATIONS ARE USED IN THE FOLLOWING ORDER —

I – **Number** *of lights if more than one, represented by the single symbol, or more than two if represented by the double symbol. The subsequent descriptions are coupled together severally by the symbol "&" when neccessary for clearness, the higher light or the port light as observed from seaward being described first.*

II – **Character** *The order of letters denoting character is that given above; where none is given the light may be assumed to be fixed.*

III – **Period** *(in seconds) between successive commencements of the same phase and* **Number of Flashes or Eclipses**, *if more than one with flashing or occulting lights or more than two with group lights. When both numbers are used they are separated by a hyphen. Where it is required to describe the individual phases, the number of flashes or eclipses is replaced by the duration of every phase in seconds, in the correct order, throughout the period and these numbers are separated by commas.*

IV – **Nature** *Where the nature is not given it may be assumed to be white. Where the duration of the phases is given the natures are shown in the same order and separated by commas. With alternating lights where the duration of the phases is not given, the nature of each flash is given in the correct order, separated by commas Where the nature of a light or phase varies irregularly, e.g. with tidal lights, or where the exact nature is not known, the fact is shown thus: r/v.*

V – **Height** *in metres above sea-level and* **Visibility** *in nautical miles from a point 5 metres above sea-level. When both numbers are given they are separated by a hyphen. When only one number is given it indicates height except when "mil" is written after the number when it indicates visibility.*

NOTE I.
Where the double symbol is used, instead of the descriptions being coupled together severally by the symbol "&" they may be tabulated, the order not having reference to the positions of the lights, thus:— $\begin{matrix}5F\\2Fr\\Fv\end{matrix}$

NOTE 2.
Where lights vary in horizontal sectors only in being masked to landward, the fact is not shown; otherwise the limitations and descriptions of such variations are shown thus –

m Cwi Cr Cwi m w m Cwi Cw Fwi Cw

EXAMPLES:—

- F 10 = Lighthouse, single light, fixed, white, 10 metres high.
- Fr/v 13-17 = Lighthouse, single light fixed, sometimes red & sometimes green, 13 metres high, visibility 17 nautical miles.
- E 10 r 7-15 = Light-ship, single light, flashing, one flash every 10 seconds, red, 7 metres high, visibility 15 nautical miles.
- TAE 60-2 rw 20-11 = Lighthouse, temporary or seasonal, single light, alternating and flashing, two flashes every minute the first red the second white, 20 metres high, visibility 11 nautical miles.
- 2C & E 90-3 & 60 w 10-10 = Light-ship with double light, higher light occulting, lower light flashing; higher light with 3 eclipses every minute and a half, lower light with one flash every minute; both lights white; both lights with a height of 10 metres and visibility of 10 nautical miles.
- 3 F rrw 10 = Three lights close together, all fixed, light on port side (approaching from seaward) and centre light red and the other light white, all lights 10 metres high.
- GE 30-1·5, 6, 5, 17·5 w, m, w, m 12-11 = Light-ship; single light; flashing; period 30 seconds; phases as follows: 1½ seconds white, 6 seconds eclipse, 5 seconds white, 17½ seconds eclipse; height 12 metres; visibility 11 nautical miles.
- F 3 mil Light buoy with fixed white light, visibility 3 nautical miles.
- AFE 60-24, 6, 24, 6 w, wi, w, ri, 33-16 = Lighthouse; alternating fixed flashing light, period 60 seconds; phase as follows: 24 seconds white, 6 seconds white flash, 24 seconds white, 6 seconds red flash; height of light 33 metres, visibility 16 nautical miles.
- $\begin{matrix}5F\\2Fr\\Fv\end{matrix}$ = Eight fixed lights. five white, two red, one green

NAMES:—

Names of lights are only given when marked so as to be visible from the air. Names where given are printed in upright Egyptian capitals, description in sloping Egyptian capitals and lower case; the normal height being 1 millimetre for the capitals and ·7 for the lower case, thus:—

GULL
GE 20-4 w 12-10

determination of drift so relatively difficult, that in any case, I suppose, we could not expect to set one's course within a considerable fraction of a degree. I do not know if you would try to set your course to the nearest half-degree?

Colonel WINTERBOTHAM: One degree, I should think.

Mr. HINKS: With the great speed the compass variation may change very rapidly; with the very rapid change of latitude you would have the continual variation of the Mercator scale soon become very apparent; and as an air-course may be set presumably without so much reference to obstructions as a course at sea, it is much more advantageous to use the great-circle course. On the other hand, calculation must be reduced to a minimum. The airman would not have time to do even the calculations, simple as they are, by those A.B.C.D. tables which the navigator uses, and consequently a map on which a straight line approximates more to the great circle would be a decided advantage. It seems to me that the International Map approximates very closely to those conditions; the great circle course is much more nearly a straight line; and we have to consider that the proposed Mercator map on the scale of 1 : 3,700,000 at the Equator becomes in our latitudes (which are, presumably, the latitudes which will be more frequently used) very closely 1 : 2,000,000. Now maps on the scale of 1 : 2,000,000 have already made considerable progress. We prepared during the war a general map of Africa on that scale, and the American Geographical Society has under way a general map of South America on that scale. Generally speaking, it is a very good and convenient scale, and it is quite certain that no errors upon that map would make the error of taking off the course from one point to another anything like as great as one degree, provided you had a ready means of measuring the deviation between your course and the nearest meridian. So it seems to me that what the International Aeronautical Map requires is not so much a completely new map on Mercator's projection, but a special edition of the 1/ 2M. There is great convenience in compilation and drawing if you have a uniform scale; and the only thing, so far as I can see, one wants to be able to do to persuade the flying man that he can use this map for navigation, as well as he can Mercator, is to provide him with a convenient way of measuring the inclination of the course to nearest meridian without using the parallel rulers and the compass rose as the sailor does. The projection of the International Map has the great advantage that it is applicable to the whole world. It can be fitted together in blocks without any very considerable difficulty, at least up to four sheets. A map on the conical orthomorphic projection, such as the projected 1/ 4M for Asia is very nice if you do not try to go too far south in Asia, but south of 20° one gets into very serious difficulties, and I cannot imagine anything more convenient generally than a uniform map on the scale of 1/ 2M. The advantage of extending the existing 1/ 2M should be seriously considered. The 1/ 2M map of Africa is not at present layer coloured, but the drafts we made for it, which are on a scale of 1/ 5M, have in these specimens been layer coloured, and I think it is quite easy to appreciate the advantage the airman would find from a layer-coloured map, although we have rather more layers here than the three simple ones considered by Colonel Lees. I do not wish to enter upon the subject of layer colour *versus* hill shading, because it is only too easy to see how much there is to be said on both sides.

The PRESIDENT: We should like to thank Colonel Lees very much indeed for his most interesting paper, which has given rise to such a valuable discussion.

Note added by Mr. HINKS :

Following upon the criticisms on the adoption of Mercator's projection made in the above discussion, Colonel Jack very kindly called a meeting at the War Office for further argument of the question. The position then taken up by the representatives of the Air Force was that Mercator's projection, and the problems of navigation associated with it, were throughly understood by the Navy, and that the training of pilots on naval lines was the most satisfactory policy. It might be true that air navigation could be conducted on other projections, but why trouble to learn a new method, when the old was satisfactory enough, and the Geographical Section were prepared to undertake the trouble involved in transferring the general land maps to Mercator's projection? The general map would have to be drawn specially in any case, with the new conventional signs, and it was not worth considering the advantage of being able to use existing maps pending the construction of new. Further attack on such a position seems to be futile. One can only regret that the traditions of sea navigation inherited by the Air Force demand the construction of a land map that will be an offence to the eye of any but a navigator.

THE CIRCULATION OF THE EARTH'S CRUST

Lieut.-Colonel E. A. Tandy, R.E. (Survey of India)

Read at the Afternoon Meeting of the Society, 14 *February* 1921.

1. Isostasy.

THE crustal movements I propose to discuss are those connected with the well-known theory of Isostasy. I believe that the theory of these movements can be so developed as to explain all the salient facts of the Earth's crust. We will therefore begin by considering how the idea of these movements has arisen, before going on to my own further suggestions.

Isostasy is based on the idea that a heterogeneous planet would naturally be "bulged where the matter is light and depressed where it is heavy." * It therefore supposes that there is everywhere the same amount of matter under equal areas, so that the matter must be denser under depressions than under elevations.

If Isostasy is a normal feature of the crust, with equal quantities of matter everywhere, it has been recognized that it would soon cease to be so, in face of the continual transfer of surface material in constant directions by weathering, erosion, etc. So that in order to maintain a condition of Isostasy, we have to suppose that these surface movements are balanced by the return of matter underground from areas of deposit to areas of denudation.

* *Vide* C. E. Dutton, on "Some of the Greater Problems of Physical Geology," Phil. Soc., Washington, *Bulletin*, vol. II (1888–91), pp. 51–64. This was the first introduction of the term "Isostasy," and also shows that the theory itself dates back to Babbage and Herschel, a century ago.

The obvious mechanism suggested to explain this process supposes the crust to be very responsive to changes of load, so that as further loads are imposed on an area of deposit it sinks to a corresponding extent, thus driving the plastic matter of the sub-crust towards the elevations and other areas which are being relieved of surface load. This sub-crustal movement in a reverse direction to the surface transfer is known as the "undertow." It has so far only been considered as acting in rather a vague and indeterminate way.

My own ideas are chiefly based on a far more lively conception of this process. I propose to describe the whole movement, above the surface and below it, as the Circulation of the Earth's Crust, because I am supposing this movement to be a universal characteristic of the crust, and the ultimate cause of all the great changes in its surface. I would also regard this Circulation as acting in the most detailed manner between every adjacent elevation and depression.

Now most theories of the Earth's crust seem to land their followers in a quagmire of contradictions; whereas Isostasy is clear and simple so far as it goes, and in accord with the main facts of crustal density as disclosed by geodesy. Also this idea of gradual sinking under deposit and rising under erosion is most definitely confirmed by thousands of geological data, and there seem to be none which are clearly against it. The theory is, however, still too incomplete to be of much use to the practical geologist, and my present object is to try and advance it a further stage in its development. Before embarking on this argument it will be necessary to refer to certain physical facts in regard to which present theories are very confused. I believe this confusion is due to their being based on the opposite assumption of a rigid and quiescent crust. However natural such an assumption may be, it must be put aside before we can deal fairly with a theory assuming great crustal mobility.

2. Deeps and Rivers.

First, as a basis for all discussion of this movement, I must challenge the very common practice of treating the silt carried by alluvial rivers as if it were the main element in surface transfer. The lakes and seas where such rivers debouch are thick with this silt because it settles so slowly and is therefore very much in evidence. Also careful estimates show that the amount of matter so discharged is often enormous. But even so, I have to suggest that equally careful estimates of the land-slides, loose rocks, and other detritus falling down a steep declivity directly into the water would show that they give a far greater deposit of solid matter per unit area than the silt from the slow-moving water channels on an equal alluvial frontage, which settles slowly over a very wide area.

This deposit from steep declivities is partly concealed from us by its rapid settlement in the water, which is therefore generally clear, and also by the very puzzling fact that the depressions below steep declivities, so

far from being filled up by this maximum deposit, are generally much deeper than elsewhere. In fact it is a matter of common observation that the steeper and more friable the declivity the deeper will be the water at its foot, and that the most shallow water will be found near flat alluvial shores.

In so far as these statements are true they can only be explained on the principle that the greatest depressions in any locality are to be found in the areas of maximum deposit, though this is the opposite of what we should naturally expect. Before trying to consider the theoretical side of this process by which deeps may be the result of deposit, and conversely, how heights may grow higher in the face of erosion, let us see how far these two principles will serve us in explaining the salient facts of seas, lakes, and rivers.

Deeps.—The results will be most clearly seen in lakes and seas where the facts of erosion and deposit are not complicated by tidal currents. In such cases, as I have said, the greatest deeps are generally found where the shore is most steep and vulnerable, and thus allows of the maximum deposit settling directly in the water without the intervention of any alluvial plain.

The Dead Sea, which is 1300 feet below sea-level, and at its maximum 1300 feet deep, offers a good example; as it receives the whole Jordan discharge, in addition to enormous deposits from desert sandstorms, and also that coming straight down the surrounding declivities. I would regard the latter as the most important factor, since the greatest deeps are, as usual, near the steepest land.

The greatest ocean deeps near land are also always at the foot of steep coastal profiles, subject to severe weather, which must bring down very great deposit from the rocky coasts and islands. The great Tuscarora Deep, fringing the Kurile Islands and Japan, is an excellent example.

Mountain Rivers.—Current theories try to explain river action as consisting chiefly of erosion. But actually, so far as I know, the beds of rivers are nearly everywhere filled deep with deposit similar to that at the surface of the bed; and this clearly points to river-beds as being predominantly areas of deposit, and not of erosion. For if the river were eroding its bed, we should surely find the virgin rock generally scraped clear of deposit instead of being loaded with it to an indefinite depth.

We may admit that the first rough scores down a mountain-side are eroded. But as soon as these collect into hill streams they nestle down amongst the hills in a bed of deposit, due to the hill stream having a far easier gradient than its tributaries, and therefore being unable to carry forward all the material it receives from them, in addition to that which falls from the steep declivities along its own sides. Similarly the mountain river has a still easier gradient, and often still greater declivities along its sides. We may therefore regard its bed as an area of still greater deposit, and we find that it sinks the deepest valleys amongst the hills accordingly.

The only important exceptions I can see to this general rule of river deposit are in such cases as the brinks of great waterfalls, where the action is clearly erosive and results in a very high river-bed accordingly. My experience is, however, chiefly confined to young folded mountains, while great waterfalls only occur in areas of horizontal strata. In such areas I fancy the Earth's Circulation may perhaps be of a more regional and less detailed character than in the case of young folded structures, which latter I regard as the direct result of a very detailed Circulation.

In any case I have no quarrel with theories as to the "cutting back" of the heads of streams, or with the great mass of valuable work which has been puzzled out with regard to river action. All I would suggest is that, certainly in young folded mountains, and probably to some extent everywhere, a mountain stream does not "carve out" its valley by erosion, but produces a very similar effect by "sinking and shrinking" into its valley under a continuous load of deposit; while the hills on its sides are steadily raised up, at least relatively, about as fast as they are eroded.

Thus, where valleys appear to have been cut down through the crests of anticlines, I would suggest that the similar strata on either side of the river have been steadily pushed up independently, as the river sank downwards between them, and that no complete anticline ever existed. Similarly I would regard the deep-sea chalk, and other similar strata which confront one another on opposite sides of the English Channel, as having been separately raised up on either coast by the Circulation. Meanwhile the sea-bed between them has been relatively sinking under deposit, and has therefore long since pushed its chalk bed downwards to unknown depths, so that the mid-channel chalk and other strata have probably never appeared above sea-level.

Current attempts to explain mountain valleys by erosion are not only opposed to the fact that stream-beds are deep with deposit, but also have to be continually qualified by the suggestion of mysterious crustal uplifts or subsidences, which they are unable to explain. My theory would aim at a more complete explanation of the facts by attacking the problem from an opposite point of view.

Alluvial Plains.—When we come out on to the alluvial plains of great rivers we are confronted by thousands upon thousands of cubic miles of deposit, reaching down beyond our deepest borings. Yet even here current theories try to explain things as far as possible by erosion, and generally attribute the deposit to very temporary floods.

Thus a common feature of such alluvial plains, as in the case of the Tigris, is for the river channel to run through the high central parts of the plain, and to be flanked on either side by lakes or marshes which lie in much lower ground. The common explanation is that when the river floods its banks (which is only occasionally, and for short periods) the maximum deposit is dropped on the high banks near the channel, owing to the sudden decrease in velocity of the water.

It seems to me that this explanation will not bear scrutiny. One does not see any signs of the floods leaving a great deposit on the high bank, and there are mounds and other parts of the high bank which are out of reach of the floods, and so cannot have been built up by them. We can certainly explain the facts more easily by saying that the marshes are the lowest parts of the plains simply because they are the areas of maximum deposit. In any case it seems quite certain that the marshes must be the areas of maximum deposit, for two reasons:

In the first place these marshes are fed from the river by great canals, sometimes almost as big as the river itself, which carry down enormous quantities of silt throughout the year. All this silt is deposited in the lakes or marshes, as is proved by the water becoming quite clear before it reaches any outlets by which the marshes may be partly drained. This continuous deposit in the marshes must be incomparably greater than any which may be left on the high banks by occasional floods.

Secondly, we have to consider the enormous sandstorms which blow about in such countries. Whenever such sandstorms pass over water, they break its surface into waves and deposit great quantities of solid matter into it. Also, so long as the water remains, nothing is ever blown away from such areas. Now the only areas which contain water all the year round are the lower parts of the lakes, marshes, and river channels, and therefore these must be the areas of maximum deposit on account of sandstorms. While, on the other hand, the areas which are seldom or never under water, and therefore liable to the maximum erosion by wind, are the high banks and mounds near the river.

The Mississippi and many other large rivers have similar lakes and marshes on their flanks. But there are also cases, as in the Nile valley, of the lowest ground being far from the river channel, but not filled with water, and therefore not so easy to explain. They may none the less prove to be similarly areas of maximum deposit, from various causes. Otherwise these may be cases only to be fully explained by later developments of my theory which cannot be discussed yet.

Alluvial Rivers.—I also regard the river channels of such alluvial plains as normally subject to steady deposit, the deeper portions being where the deposit is greatest. The outstanding fact about such rivers is that they insist on having a grade which steadily decreases in steepness as we go downstream, so that when they flow into a steeper part of the plains they always create meanders sufficiently long to allow them to enjoy the necessary decreasing grade.

Current explanations of these facts are complicated, and to my mind unconvincing. From our new point of view we would simply say that such rivers normally carry along as much silt as the strength of their current will permit; and that the decreasing grade is necessary to ensure a current which is becoming steadily weaker, and thus to allow of the river-bed being continuously sunk under steady deposit. When the river finds

a steeper gradient, as by cutting across the neck of a meander, it suddenly removes a great load of material from its new channel, and then continues to erode its bed owing to increased velocity. On the side where this erosion is greatest the bed will begin to rise, and so drive the water to cut into the opposite bank. This cutting causes the bank to keep tumbling into the river, so that on the cutting side we have great deposit and deep water. The meander thus continues working outwards in this direction until it has become long enough to provide such a decreasing grade as will allow of normal deposit being resumed.

I am thus opposed to the general view that the deep channel in concave bends is the result of scour. I have noticed, where hill streams first debouch from the Himalayas into the alluvium, that quicksands are constantly found in these concave bends, and that one's elephant is very chary of wading near such places. Quicksands are, I think, only found in areas of deposit, and may be described as the crustal Circulation in visible operation.

The mysterious way in which strong swimmers may be sucked down by great rivers, and the rate at which such rivers are apt to swallow up anchors and cables, together with the way in which river action can be impeded by great masonry works or aprons, seem to show that quicksands are a common feature of the river-bed, and that the deposit perhaps works downwards by means of small vortices whose action is checked by wide masonry works.

However, I have only time now to present the salient features of the theory in their most uncompromising form. And however imperfect this rough sketch may be, we must remember that the current view leads to theories so complicated, and so useless for practical purposes, that high authorities will say, "You cannot legislate for the caprices of an alluvial river." This simply means that their laws are not yet known, and that there is probably something wrong in the fundamental assumptions upon which we have been working.

3. River Deltas.

The deltas of alluvial rivers require special mention because the whole theory of Circulation depends on the crust being very sensitive to changes of load, whereas the late Mr. J. Barrell, in his recent important work on "The Strength of the Earth's Crust" (American *Journal of Geology*, vols. 22 and 23, 1914 and 1915), uses deltas to show that the crust is very strong. He does this by showing the contoured plans of two deltas and the surrounding sea floors. For these two selected deltas the contours certainly look just as if the delta alluvium were superposed upon a continuous sea floor. He then simply assumes that this is the case, draws imaginary sections accordingly, and then calculates the weight of the alluvium as a proof of the enormous loads which the crust can support!

From our new point of view we would regard the greater deepness of the adjacent sea floor as due to its being an area of greater deposit than that occurring on the delta frontage; and there are good reasons for thinking that this is probably the case. However natural Mr. Barrell's assumption may be, it is thus evident that in making it he simply begs the whole question from our point of view. His view is indeed exactly similar to the old natural assumption which regarded the mountains as so much extra matter superposed upon a uniform crust. Geodesy has shown that this major assumption is certainly wrong, though I do not think it yet affords any definite evidence, one way or the other, in regard to the minor question of deltas.

This example, which is being seriously advanced as direct geologic evidence of the strength of the Earth's crust, may give us some idea of the endless unjustifiable assumptions which may be found everywhere entangled with the real facts, as soon as we begin to examine them in a new light. For instance, every geologist knows how different most geological sections might become if redrawn in the light of a new theory, even without the addition of fresh facts which that theory would probably disclose.

We hardly need new facts in the present case, as borings into delta alluvium show that it extends far below sea-level, and this seems clear evidence that the crust is not rigid, but steadily sinking under the river deposits.* However, it may be as well to supplement this by a brief explanation of the grounds on which we may expect to find greater deposit on the flanks of deltas than on their frontage.

Firstly, when the flanking shores have steep declivities the sea below them may receive much more deposit than that near the alluvial frontage of the delta, as already discussed.

Secondly, if the delta is flanked by deserts there will often be violent sandstorms blowing into the sea. These may be moving ten to fifty times as fast as the silt in a delta channel, and will have a cross-section hundreds of times as great as the total cross-sections of the little river channels on an equal frontage of delta. Such sandstorms may therefore be capable of blowing as much solid matter into the sea in a few days as an equal frontage of delta would receive in the shape of silt in a year.

Thirdly, we have the fact that silt is far more rapidly deposited in salt water than in fresh water; so that the more saline water on the flanks of a delta should cause its silt to settle more rapidly there than in the centre of its frontage where the water will generally be fresher.

These and other such causes may combine in different ways to give us

* The river channels have very little depth, and their surface must be somewhat above sea-level, so that *river* deposits cannot be laid down much below sea-level, and if they are found at great depths in a delta, they must have sunk since they were laid down. If they had been built up on a sea floor they would have the characteristics of marine deposits. The distinction should be most marked in a tideless sea.

different forms of delta. Thus I fancy that the "bird-foot" delta of the Mississippi may be due to greater salinity on the flanks of the streams causing those flanks to sink under greater deposit, so as to leave the main channels of fresher water sticking out into the sea, like fingers.

Again, some deltas, as that at the head of the Bay of Bengal, have very marked depressions cutting through the coastal platform. I regard these as due to excessive deposit. I have been told that the flood tides flowing northwards along the two sides of the Bay meet in a line above this so-called "swatch of no ground." This would give us maximum slack water over this area, and therefore maximum deposit. This conclusion is supported by the fact that the bottom consists of soft mud and ooze. My complete theory does not at all insist that an area of maximum deposit must always be deepest. But in these cases it seems to be so, and I will therefore venture to guess that, wherever such marked depressions are found in silt-encumbered seas, inquiry will show that they are areas of maximum slack water, or of maximum salinity, or in any case, for some reason, areas of maximum deposit.

These features are sometimes attributed to sunken river-beds, or to pre-historic cracks in the crust, though they are often not at all like either in shape. Also it seems to me that the surging silted waters would obliterate anything of the kind in a very short time, and that we must therefore explain their maintenance by processes which are in continuous operation at the present moment.

4. Differences of Crustal Temperature.

I will now turn to quite a different theory of the Earth's crust, which has been urged by some geologists but has not yet, so far as I know, been combined with the theory of Isostasy: namely, the idea that "Differences of elevation in the surface of the Earth are due to differences of crustal temperature." So that every elevation would be due to expansion of the crust by excess of heat.

This idea is in natural and remarkable harmony with the main principle of Isostasy. Since instead of having to explain Isostasy by rather artificial postulates as to mountains being "compensated" by deficiencies of density below them, we would simply say that the crust in high regions consists of expanded matter, and that in low regions of relatively condensed matter, the differences of expansion being chiefly due to differences of crustal temperature. It is also evident that, if this is the case, the greater heat under elevations will tend to spread by conduction in the crust, both laterally to the colder crust in the neighbourhood, and downwards towards the centre of the Earth.

I believe on general grounds that this idea, if suitably combined with others I have to suggest, would satisfy the outstanding facts of geodesy more completely than simple Isostasy has yet been able to do. But this is a question requiring mathematical investigation, and I have no time to

discuss it this evening; but will now pass on to the most important suggestion which I have to make, namely:

That the varied expansion of the crust shown by differences of elevation at its surface may be due to differences of crustal temperature and chemical changes generated by the Circulation of the Earth's crust.

This conception is the necessary and natural link between the two well-known theories under consideration, namely, the theory of Isostasy and the theory of crustal temperatures; since the crustal movements which Isostasy requires to explain its maintenance would thus become the prime cause of the isostatic condition itself, and might also afford a far more satisfactory explanation of the crustal expansion of elevations by heat than any theory which has yet been suggested.

I also believe that the fuller theory of Circulation which may be developed from this idea will be found capable of giving a more complete and detailed explanation of the salient facts of the Earth's crust than any current theory is able to attempt. The only serious difficulty arises from the question whether the Circulation can possibly be found competent to produce the required differences of temperature. I shall now try to meet this difficulty by developing the idea of a far more active and powerful Circulation than has hitherto been conceived, and will begin by stating the crustal conditions which I would associate with the theory.

5. Crustal Conditions.

We may start with a very prevalent view of the Earth's crust, by which it may be described as consisting of a solid upper crust and a plastic sub-crust. These two parts of the crust merge insensibly into one another and into the Earth's nucleus below them.

We may define the lower limit of the crust as that depth where the plastic sub-crust becomes incapable of movement owing to increase of pressure. It is considered doubtful if movement is generally possible after depths of 30 miles or so, though in my view this depth will vary greatly according to the activity of the Circulation. Beyond this depth things merge into the condition of the nucleus, which we will provisionally regard as inherently solid, cold, and inert. By this I simply mean that I am not bringing in the nucleus as a source of crustal activity, though it will be sensibly expanded by heat to very great depths at those points where the crustal temperature is highest.

Again, since we suppose depressions to consist of a colder crust than elevations, we may reasonably conclude that in depressions the solid upper crust will be thicker, and the plastic sub-crust thinner, than in the case of elevations. We would thus have a stiffer crust under oceans and seas to account for their crustal strength in resisting changes of load due to tidal movements of the sea, while still allowing ourselves more mobile conditions in higher ground to explain the great sensitiveness to load which our theory requires in such regions. I believe Milne found that

the greatest earthquakes of Japan had their seat in the bed of the Tuscarora Deep, and that the shocks became steadily milder for earthquakes seated in higher regions, until they finally faded away at the tops of the volcanoes. This would exactly agree with our views of crustal stiffness, and thus support the theory of crustal temperatures upon which they are based.

Since the undertow is the movement of this plastic sub-crust from areas of deposit to areas of denudation, this idea of its having a thicker solid crust above it in the case of depressions at once provides the possibility of greater pressure on the sub-crust under depressions, which would help to drive the undertow towards neighbouring elevations, where the upper crust will be thinner. We may, however, suppose this driving force to be considerably enhanced, as follows :

Unequal Loading, not Isostasy.—It is evident that if we have perfect Isostasy, with the same amount of matter in every vertical line from the centre of the Earth to the surface, we can only suggest differences in the vertical distribution of this matter in order to provide the differences of pressure necessary to produce movements.

Such differences in the vertical distribution of identical loads do not seem enough for my purpose. I want a more dynamic condition, with far more powerful forces available for the active Circulation of the crust. With this object I suggest that in their gradual evolution all natural depressions have become overloaded, and all natural elevations underloaded : and that this overloading at one end of the undertow, combined with the underloading at the other end, is just sufficient to overcome the intervening friction ; so that any further transfer of surface load at once produces crustal movement.*

Some more suitable term than Isostasy is needed to denote this definite conception of unequal loadings up to the point of causing movement. But at present I can only suggest that my proposed title, describing the whole process as the "Circulation of the Earth's Crust," should be held to include implicitly all these new developments of the ideas included under the older term Isostasy ; though actually this new title would have suited the theory well enough at any stage of its history.

6. Generation of Heat by the Circulation.

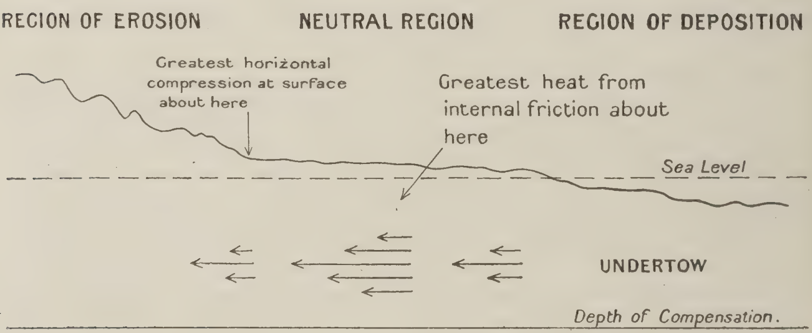
Armed with these ideas of crustal conditions and a more active and powerful Circulation than simple Isostasy could provide, we may now return to the main question as to whether the differences of crustal

* Many coral islands, which are steadily sinking under deposit, would appear to be exceptional cases of elevations which must be overloaded. Also volcanoes, just after eruption, may sometimes be more or less overloaded until erosion has relieved them again. These cases seem capable of explanation ; but I do not yet see why certain quicksands, which are evidently rapidly sinking areas of deposit, should take the form of shoals, as in the case of Goodwin Sands.

temperature can be due to heat generated by the Circulation. Those who believe that differences of elevation are due to differences of crustal temperature have usually explained the latter by supposed inequalities of temperature in the nucleus. But this merely drives the mystery deeper, since these supposed differences of nucleal temperature are not connected with any known facts which would locate their greatest heat at the places where we find the greatest elevations.

Now the first thing our theory must do is to show that the maximum heat will be generated by the Circulation where we want it, namely under the greatest elevations, and that the least heat will be under the lowest depressions. This means that the maximum transfer of surface material must be located in the highest mountains, and the minimum in the central ocean deeps.

In order to show that this is the case, we may begin by considering the following diagram, which is taken from a paper by Dr. H. J. Hayford in



the American journal *Science*, Feb. 1911, and which gives a good general idea of the Circulation as it has been regarded up to the present time.

It will be seen that this diagram is based on the current conception which only considers the transport of material by rivers from distant mountains across alluvial plains to the sea. It accordingly puts the maximum surface transfer, and therefore the maximum heat generated by the undertow, not under the elevations, where we would like to see it, but midway between the mountains and the sea.

The reasoning is of course valid, so far as it goes. But, as we have already seen, my more detailed view of the Circulation would regard every river, stream, and depression as a sinking area of deposit; and from this point of view the distant transfer of material becomes a most insignificant part of the crustal activity.

I imagine that far more stuff comes tumbling down the myriad peaks and slopes of the Himalayas in a short burst of monsoon weather than the rivers can deliver into the sea in a year. In my view the greatest surface transfer of material occurs down the steepest slopes under maximum

stress of weather. And since steep slopes are most numerous, and the weather most active and effective, in mountain regions, we may fairly argue that the maximum crustal Circulation, due to surface transfer of material, will be found in mountain regions. On the other hand, it is known that in the central ocean deeps there is hardly any surface transfer through long ages, so that these will be the areas of minimum Circulation.

We have thus got our first essential in placing the greatest heat generated by the Circulation where we want it. But we must still feel it very difficult to suppose that so small a cause as the transfer of surface material can possibly produce sufficient differences of heat to account for the great differences of surface elevation. Against this feeling I would urge the following arguments:

(1) The whole theory must stand or fall on the principle that the Circulation is of the most detailed character, so that every stream and depression in the mountains will be an area of deposit, as already discussed. The highest mountains of the world are all very steep folded mountains, and the avalanches, land-slides, and other erosion down the sides of such mountains must be enormous. So that if we believe that the great bulk of this deposit is not carried forward, but sinks directly into the beds of the streams and rivers, and finally circulates back under the adjoining heights and spurs, we at once get a Circulation far more powerful and rapid than has hitherto been conceived. For its real rate of action is, by its very nature, almost entirely concealed from view, and I think its quantity may easily amount to hundreds of thousands of tons of material per annum for a single mountain valley.

(2) As we have already seen, the power available to generate heat may be still greater than this surface transfer. Since it depends on the difference between the overloading in a depression and the underloading of the neighbouring elevation, as accumulated during long ages of evolution. And pending more detailed research, we may suppose the power thus available to be very great under maximum conditions.

(3) The resultant temperature and expansion of the crust in high regions will also be due to long ages of such action. Rocks are poor conductors, so that the leakage of heat through the crust will be slow. And so long as the heat is generated ever so little faster than it is lost, we can, in time, work up to any required differences of temperature. Of course the greater such differences become the more rapid will be the loss of heat by conduction. But up to a certain point this rapid loss of heat may be easily compensated by the fact that the steeper slopes at the surface, arising from the greater differences of crustal temperature, will promote surface transfer, and therefore a more active generation of heat by the Circulation.

(4) Chemical changes may greatly reinforce the expansions and contractions due to heat. And such chemical changes may perhaps be more effective where the Circulation is most rapid, as in mountain regions.

(5) Finally, it is to be remembered that, although they seem so impressive to us, the major surface features of the globe are extremely gentle undulations, whose maximum differences of elevation from the mean surface are seldom more than the one-thousandth part of the radius of the Earth. On the other hand, the high temperatures accumulated through long ages of active Circulation, may, by conduction, extend very deep down into the nucleus. So that altogether we have a great depth through which to distribute the expansions necessary to cause the comparatively slight elevations at the surface.

The combined effect of all these considerations greatly increases the general plausibility of the hypothesis. And I hardly think it is possible to attempt much more than this at present. We first have to consider on general grounds how far the theory seems to accord with known facts. And then, before we can do any useful calculation, we shall have to re-examine many of the facts of surface erosion from a new point of view, which will probably give them quite a new complexion. Also we need to examine the theory in the light of geodesy, in order to get some idea as to how far down sensible expansion of the nucleus extends for different elevations, etc., etc.

7. Contraction and Expansion.

When I spoke just now of the central ocean deeps being areas of minimum Circulation, and therefore the lowest depressions on the face of the Earth, I am sure many will have noticed that this still left unexplained the great coastal deeps of the ocean, which, though far smaller, are often as deep as the central Pacific. These coastal deeps cannot be attributed to absence of Circulation. Indeed, I have already used them, at the beginning of the lecture, as examples of deeps due to excessive deposit. I also gave many other examples of the greatest depressions being under the areas of maximum deposit; and we will now consider how this very prevalent fact in Nature may be explained.

The current theory on the subject, which has been prevalent for at least a hundred years, is that when a deposit is laid down it acts as a blanket in preventing the radiation of heat from the crust beneath, so that the deposit will increase the crustal temperature at that point. I believe that this most plausible idea has been one of the greatest obstacles to the progress of the Circulation theory, because it really belongs to our natural conception of a more or less rigid crust.

For if we adopt a more lively idea of the Circulation of the crust, which postulates that the vertical column below the deposit is steadily sinking about as fast as the load is placed upon it, we shall find that the crust under such an area, so far from being heated up by blanketing, may really be cooled by the process. For if one pushes a cold body into a hotter layer the body itself will be heated, but the layer will be cooled, and the mean temperature of the two will be less than that of the hot

layer; and so long as we go on pushing in colder stuff, its mean temperature, and that in its vicinity, will be less than in other parts of the hot layer. Now the Earth's crust may be described as consisting of successive layers which are steadily hotter as we go down. A sinking column of this crust will therefore always have the effect of intruding colder layers amongst hotter ones, so that the mean temperature at every depth of this sinking column will be less than that of its surroundings.

Since this sinking matter will naturally be more condensed than its surroundings, owing to its lower temperature, we thus arrive at the view that the crust may be not only sinking but shrinking in areas of deposit. Conversely, we may suppose that the rising matter under an elevation would not only raise it upwards by direct pressure, but would also expand the crust beneath by the continual intrusion of hotter layers from below into the colder layers above them.

This condensation in sinking areas of deposit, and the expansion of rising elevations, may be greatly reinforced in other ways, as follows:

Firstly, chemical changes may assist the action, especially in the presence of water, which accumulates in areas of depression, while rock rising up from below may be expanded by hydration and other such processes.* It is to be remembered that, in spite of its cooling effect, the matter in a sinking column will be steadily becoming hotter, just as a rising column will itself be cooled, although heating up its surroundings.

Secondly, owing to the spherical shape of the Earth, rising matter will always be entering into a wider part of the sector in which it is confined, while sinking matter will be squeezed into a smaller compass, in so far as its particles move vertically towards the centre of the Earth.† These changes in lateral compression will also be greatly reinforced by vertical pressure, which will be constantly increasing in the case of matter which is sinking, and decreasing when matter is rising.

* 'The Evolution of Earth Structure,' by T. Mellard Reade, suggests many interesting possibilities of this kind, and includes the following footnote, which seems to indicate just the sort of theory we might combine with the Circulation theory, to their great mutual advantage:

"In a carefully thought-out treatise of much originality on 'Metamorphism of Rocks and Rock Flowage' (*Bulletin of the Geol. Soc. of America*, vol. 9, pp. 269–328; 1898), Van Hise shows in considerable detail that these mineral changes often result in increase of bulk and evolution of heat; in other cases in decrease of bulk and absorption of heat. He also points out that pressure and temperature are main factors in these mineralogical transformations. Finally, he comes to the conclusion that there exist in the earth's crust two 'physico-chemical zones,' an 'upper' and a 'lower.' 'In the upper of these the reactions take place with the expansion of volume and with the liberation of heat as end results. In the lower the reactions take place with contraction of volume and with the absorption of heat as end results. Some of the more important reactions in the upper zone are hydration, oxidation, and carbonation; some of the more important reactions in the lower zone are dehydration, sulphidation, and silication.'"

Suggestions of this kind, however, can only be properly worked out by specialists.

† For every rise or fall of 100 feet a square mile of rock must gain or lose over 250 square feet of area on this account. So that for a mile of rise or fall we get a change in area of nearly 14,000 square feet per square mile.

Thirdly, wet soil is a far better conductor of heat than dry soil, so that the loss of crustal heat by radiation at the surface may be much more rapid through the wetter crust of depressions than elsewhere.

I can do no more at present than to offer these rough hints to show how, in favourable circumstances, an active Circulation may assist deeps to become deeper and heights higher. But fortunately we are here up against physical facts. And as soon as it becomes duly recognized, for instance, that the greatest depths in a lake are generally the areas of maximum deposit, it will be clear that the Circulation theory offers the best hope of explaining the fact, and suitable specialists will soon discover how that theory requires to be reinforced in order to make the explanation complete.

8. Evidence and Examples.

Rising Areas of Erosion.—Many geologists have recognized that mountains have grown up in the face of erosion, though, in the absence of any theory to explain it, they will only accept the fact in those cases where the evidence is conclusive, as on the Himalayan frontage. We therefore find, as in the case of sinking areas of deposit, that the facts connected with rising areas of erosion have often been overlooked or misstated on account of the natural human bias in favour of a rigid crust.

Thus it is the custom to explain mountain peaks and coastal promontories by saying that they are of harder rock which has better resisted erosion. This does not show how such rocks have been brought to the surface, and is also often quite untrue, as in the case of great outcrops of so soft and friable a rock as gypsum.* And even where the rock is hard in grain, its steepness and its faulted structure in peaks and promontories are most favourable to rapid breaking down. The whole facts could therefore be better explained by saying: firstly, that where hard rocks have been brought up to the surface, this is due to their being in positions where the weather and the tides act most vigorously, as is the case with peaks and promontories; and secondly, that softer rock is raised above its surroundings by its greater liability to erosion.

I have seen so-called "stationary" sandhills in the great Indian desert, rising high out of much harder ground, though they were being blown away so fast that nothing could grow on them. Surely these can only be explained as "pockets" of looser sand, which are being raised above their surroundings because of their more rapid erosion? Similarly, current theories can afford no satisfactory explanation of the rise of offshore bars and coastal sandhills.† But this should become easy, once we can call

* The article on p. 582 of the American *Journal of Geology*, vol. **22**, 1914, shows how such cases have to be explained by rather special pleading under current theories. It also shows the great chemical expansion which may assist certain rocks when rising up in the face of erosion.

† 'Shore Processes and Shoreline Development,' by D. W. Johnson (New York, 1919), pp. 350 onwards. This valuable work quotes the highest authorities of various countries.

in wind erosion as a means of raising them after tidal erosion has brought them to the surface, with the assistance of crustal conduction of heat from higher areas in the neighbourhood.

There is plenty of very definite geologic evidence in favour of heights being due to erosion, such as the fact that Plutonic rock forms the crests of all the highest mountains in the world. But all this, like the evidence of sediments having been formed by steady sinking under a continuous load of deposit, has been discussed before now in connection with Isostasy. I need therefore only indicate how my further developments of the theory would enable previous explanations to be amplified in greater detail.

Further Illustrations.—Volcanoes are a vivid example of the Circulation of the crust in violent operation, with the undertow bursting out at the tops of the heights, where we now expect the crust to be weakest and most underloaded. Also the greatest volcanoes, like the greatest earthquakes, only occur on steep coastal profiles, where we have great transfer of surface material, and therefore an active Circulation, and where this is associated with a very stiff crust in the bed of the sea, such as would be likely to give way under deposit by means of violent and intermittent jerks. The crust of high folded mountains, on the other hand, is everywhere higher and more plastic; and therefore, in spite of its very active Circulation, not subject to such extreme shocks as the stiff sea floors at the foot of coastal profiles.

Dutton claimed that the "fan-structure," which is the typical cross-section of folded mountains, together with the overthrust faults along their frontage, are in broad agreement with the theory. But we can now go further than this, and should be able to explain the detailed complications of their structure by means of the lateral thrusts of the various undertows pressing from different directions towards the roots of every peak and spur, combined with all the upward and downward movements which we suppose to be actively at work in a region of folded mountains.

9. Conclusion.

We must, however, leave these details now, in order to consider more fully how the theory would work as a whole. To begin with, we have our main idea, that wherever the Circulation is greatest, that is wherever the action of the weather and tides is most effective, we shall have the greatest elevations and the steepest profiles.

But on the other hand, it is evident that this weather effect must always be greatly modified by leakage of heat in the crust, which will be most rapid where the differences of crustal temperature are greatest. So that although exposed to the fiercest weather a coastal elevation may be less high than a more inland one, owing to its more rapid loss of heat to the cold crust of the neighbouring ocean or sea. Conversely, the deeps resulting from deposit, or those due to absence of Circulation, will be

assisted by cold and low surroundings, since neighbouring elevations would tend to raise their crustal temperature by conduction.

By different combinations of these contrary effects of weather and crustal conduction, we can, I think, plausibly explain most of the broad facts of physical geography. For instance, the mountainous areas of the British Isles all face the weather, and the oldest rocks have been gradually brought to the surface by erosion where the tidal and weather attack has been fiercest and most prolonged. But such areas are often not the highest because of their loss of crustal heat to the neighbouring oceans and seas. Thus Cornwall, with deep seas on either side, and the west of Ireland, with a still deeper ocean before it, cannot attain to such elevations as Wales, which, while also well exposed to the weather, is situated amongst higher and therefore crustally warmer surroundings.

Again, if we consider the violent attack of the monsoon weather on the southern frontage of the Himalayas, we shall find that frontage steadily raising up its foothills range by range out of its "foredeep," in face of that weather. This may be roughly explained as due to the conduction of crustal heat from the higher mountains aiding the foothills to rise in the face of erosion. Meanwhile we find the great spurs, carrying the loftiest peaks, all face the weather, so that their growth must have gradually protected the watershed behind them from weather attack. The crustal Circulation of this watershed has thus been steadily diminished, and it is therefore no longer able to maintain a great crustal heat in the face of losses by conduction. It thus steadily loses height, and subsides into the condition of the lower Tibetan plateau behind it. And we may further suppose that the great spurs will gradually pass through similar changes in their turn, as they become more and more protected by the rising of their frontage. We thus have the idea of a rising and advancing frontage, followed by a subsiding area behind the highest array of peaks.*

So far as it goes I think this is in general agreement with the facts, and in any case it will serve the purpose of showing how we may explain the gradual advance of any given set of surface features from one region to another. And as changes in these features will in turn modify the weather, it is clear that the complete theory might be made to explain the gradual transformation of both the weather and surface conditions in any given area.

Crustal Mobility.—This is about as far as I can carry these speculations at present; and I feel that their greatest difficulties may arise from the current habits of geological thought, since we cannot easily get rid of the ideas that deposits cause "blanketing," that elevations tend to get worn down into "peneplains" by "cycles of erosion," that streams are "rejuvenated" after wide intervals of time, and so forth. Now these are

* I do not know whether any great advance of the main axis has certainly taken place in this particular case. But it seems certain that the frontage has advanced in face of the weather, by raising up successive foothills from the alluvial plains.

not facts, but rival theories, largely due to our crude natural bias in favour of an inert and rigid crust. So they should not be allowed to embarrass a theory based on the opposite assumption of extreme crustal mobility. But in practice it will be hard to prevent this, since all the facts have been examined and collated in the light of these "intermittently-rigid" theories. From my point of view, even the relics of this natural bias may prove as great a source of confusion in geology as the natural human feeling that the sun goes round the Earth used to be in the case of astronomy.

However, the great point is that the ideas I have sketched out do offer the prospect of a complete theory providing incessant crustal activity of the most detailed character. The evidence in favour of such activity is overwhelming. So that once a theory can be found to explain it, we may hope that it will not be too long before we can all accept, in their fullest sense, the great lines from Tennyson's "In Memoriam," which have been so often quoted by eminent geologists:

> "There flows the deep where grew the tree.
> O Earth, what changes hast thou seen!
> There where the long street roars, hath been
> The stillness of the central sea.
>
> "The hills are shadows, and they flow
> From form to form, and nothing stands;
> They melt like mists, the solid lands,
> Like clouds they shape themselves and go."

Before the paper the PRESIDENT said: Colonel Tandy is an officer of the Survey of India who has for some time made a special study of the subject about which he will address us this afternoon. I invite him to give us his address.

Colonel Tandy then read the paper printed above, and a discussion followed.

Colonel Sir GERALD LENOX-CONYNGHAM: Colonel Tandy's very attractive theory gives one so much food for thought that he must not complain if his audience suffers slightly from sensations of mental indigestion. It seems to me that the path to the acceptance of this theory is strewn with serious difficulties, and I think, however attractive the theory as a whole may be, it is one's business to point out those difficulties which occur on hearing the lecture read.

I find great difficulty in thinking that there is a very detailed response to the relief of load by erosion and the overloading of areas of deposition. Mr. Hayford in his investigation of Isostasy found that isostatic compensation is probably complete at a depth of 70 miles. He did not, as far as I am aware, make any estimate of the depth at which the compensation might begin to take place—that is to say, at which the undertow would commence. But the sort of idea is that this is not likely to begin at a less depth than 30 or 40 miles, and if I am not mistaken, seismologists demand a rigid Earth to a greater depth than that—I speak under correction. If that is the sort of depth at which the undertow can begin, I find it difficult to believe that the bed of a mountain stream into which deposit is being poured from the hillsides can sink downwards and cause the hill alongside it to rise upwards. Different mountain streams which are cutting through the hills are separated by no great distances, so that this

conception demands an extremely detailed response in the action of the undertow. Also, at any moment in the life of a mountain stream it seems to me that the load on its bed must be something less than it had been when its bed had cut less deeply into the valley. There must be less load on it than before, so that I do not see where the weight which could depress is to be found.

Colonel Tandy spoke of deltas and of Mr. Barrell's argument that a delta showed that the crust had great strength. He mentioned that borings showed that alluvial matter extended well below sea-level. I am not familiar with the literature on this subject, and I do not know whether borings show that the alluvial matter extends below the floor of the adjoining ocean. If it only goes below sea-level I do not think the argument that alluvial matter has sunk down is convincing. If the matter goes down deeper than the floor of the adjoining ocean then I think that is an important and good argument.

Colonel Tandy postulates a state of things in which there is a good deal of overload on areas of deposition and underload in areas of erosion, so that a small extra load taken off the one side and placed on the other will cause the undertow to begin to act. Now the evidence that isostatic equilibrium really exists is pretty strong, and this state, of there being overload and underload, seems to me inconsistent with it. I think that is a difficulty which we would have to meet. I do not feel competent to go into the question of whether transference of matter by erosion gives sufficient power to cause hills to be raised up. I take it that the transference of matter is the primary force which Colonel Tandy has in view to produce the motive power which builds up mountains, and I think the amount of power available should be calculable. I think observation should be able to give us a good estimate of what power is available. The amount of erosion might be measured, and approximately the distance to which it has been carried vertically and these would give the force available for mountain building.

I also find great difficulty in understanding how the fact of depositing matter on an area should press it down to a lower level than that which it originally had. If there is isostatic equilibrium and you then place an additional load on an area it should certainly sink downwards, but the matter deposited will be almost certainly less dense than the matter deeper down in the column, and therefore a sinking amounting to less than the depth of the deposit should suffice to restore the equilibrium.

Dr. J. W. Evans: We ought to be very grateful to Colonel Tandy for his boldness in placing before us his novel ideas. He reminds one of brilliant debaters like Chesterton and Shaw who bring forward social theories which are exactly the contrary to what we always supposed to be true—and make out a remarkably good case! In the same way, I think Colonel Tandy has made out a case which has a great deal to be said for it, but if he won't mind my saying so, I believe there is as deep a paradox in his explanations and arguments as those that often lie behind the expositions of Chesterton and Shaw. I am at one with him in the importance that he attaches to the phenomenon of Isostasy—to the idea that where the balance of the crust of the Earth is disturbed by one reason or another, it tends to adjust itself like the surface of water—or still better, the surface of a bowl of treacle. Isostasy is merely a tendency to the restoration of equilibrium. This is never perfectly achieved. It is an ideal to which the Earth's crust is always tending. Just as "Man never is but always to be blest," the Earth's crust never is but always to be ultimately made isostatic.

Equilibrium is disturbed not only by the transference of material from the

mountain tops to the ocean deeps or the plains, but also by movements in the Earth's crust. Where there is compression there is the Earth folding. In some cases the Earth's crust is forced upwards. If the masses which are forced upwards are large enough, sooner or later the weakness of the Earth's crust allows them to sink again and lose the elevation which has been imparted to them by compression. Elsewhere the crust is forced down. That also tends ultimately to be corrected. In other places, a complex aggregate of corrugations results, which constitutes an extra weight that disturbs the equilibrium. But it slowly sinks down till equilibrium is restored. But there is another way in which the equilibrium may be disturbed. In some places the Earth's crust has a tendency to gape. Instead of compression there is tension and one portion moves away from the other. If such a gap is wholly or partially filled from the heavy magma below, the isostatic balance is again disturbed.

As soon as equilibrium is disturbed there is a tendency to restore the balance. This tendency takes time to develop, and the time required depends upon the relation of the forces which are generated by the want of equilibrium to the strength of the materials of the crust. If the force is very small an isostatic balance will never be obtained. Suppose a block of granite 10 feet each way were placed on a sandstone or granite plain. A thousand million years would not suffice to cause it to disappear by isostatic action. The want of equilibrium must be on a sufficiently large scale for the forces developed to be larger than the strength of the materials involved, and that constitutes a very serious objection to one portion of Colonel Tandy's theory; for he believes isostatic adjustments to take place in comparatively small areas. But it is the results that he supposes to ensue from these movements which are the most difficult to understand. He wishes us to believe if you have a large amount of material taken from the mountain top and accumulated in the adjoining valley, that this causes a deepening of the valley and an underflow towards the mountain, and that the friction of this flow generates sufficient heat to raise the mountain still higher. That seems to me a most extraordinary case of perpetual motion. The energy of position of the materials descending the mountain side is converted into energy of motion, and that is converted into heat when the motion is arrested and this heat is mostly radiated into space. At the same time the weight of the fallen material is supposed to cause the valley bottom to sink, and this to give rise to a slow underground movement towards the mountain. All the energy of that motion must be derived from a small fraction of the original energy of the descent down the mountain side and yet this is supposed to generate, by means of friction, sufficient heat to raise the mountain higher than before!

Colonel Tandy has attacked the theory of the blanketing, first enunciated I believe by Dana, who showed that an accumulation of material on the sea bottom may act as a sort of blanket to the rocks below. As heat is always coming from the Earth, the rocks below these accumulations will become heated, and the increase of heat may be so great that hard resistant rocks may become softer and unable to resist the compression of the Earth's crust. At the same time the accumulated weight will tend to force that particular point downwards. The result of compression in a region of accumulation is therefore to produce a downward bend of the ocean floor. This is the cause of the strip of deep water which is so frequently found in great oceans in the neighbourhood of continents.

Colonel Tandy's paper is so full of original ideas, so full of statements

which one would like to contest, that I could have said much more if time had permitted. As it is I will conclude by expressing my opinion that it is all to the good that we should have such papers brought before us. We are too apt to think that certain fundamental propositions are firmly established for ever. We should always be critical of the conclusions which have been arrived at, and should welcome an *advocatus diaboli* like Colonel Tandy who comes and ells us that we are all wrong, though he may not succeed in convincing us that this is the case.

Mr. A. R. HINKS: I have seen a good deal of this paper, and although I am not in the least competent to discuss the geological points which are put forward by Colonel Tandy, I should like to make one or two remarks about the attacks that have been made upon him in the discussion. Sir Gerald Lenox-Conyngham has brought forward Hayford's depth of isostasy at 70 miles or so, as if in his opinion it in any way controverted Colonel Tandy's views. I should like to demur to that idea on two grounds, first of all that Hayford never considered isostasy in any detail at all but as a broad principle; and secondly, that I have always felt his numerical conclusions were singularly badly based. Therefore, on two grounds I should demur to using Hayford as a name to throw at Colonel Tandy. And as to what Dr. Evans has said, I should like to make two or three observations. Colonel Tandy has been called bad names like Bernard Shaw and *advocatus diaboli*: I wondered myself they did not call him De Morgan, who wrote a very celebrated and interesting book: 'A Budget of Paradoxes.' That, however, is by the way. Dr. Evans said, with perfect conviction, that if you had a cube of granite 10 feet a side and set it out on the level ground it would not sink by means of isostasy. I should like to ask Dr. Evans how he knows that? It would, I believe, be perfectly possible to have said with equal confidence before Kelvin did a celebrated experiment in his laboratory, that suppose you took a jar of water and you put in it halfway up a layer of pitch about $1\frac{1}{2}$ inches thick, and that underneath the pitch you had a small fragment of cork, and above the pitch a small fragment of heavy wood, those things would stay there for ever—that the very small forces acting upon the pitch would not have been enough to carry the cork up and the wood down. But in the course of six months or so the piece of cork below appeared at the top and the wood below. There is also one other point on the extraordinary case of perpetual motion, about which Dr. Evans made some discreet fun. I do not think he did justice to Colonel Tandy in that, because if a geologist is prepared to admit that the mountains have risen rather recently (some of the very highest), there must be energy available to produce that rising, and I do not see why Colonel Tandy is not to be allowed to appropriate some of that energy which is freely used by other geologists, and why he should be expected to provide the whole of this energy for the process he advocates by the stuff falling down the mountain side. I think he is at liberty to draw upon that source of energy like any other geologist.

Lieut.-Col. TANDY: I must thank Mr. Hinks for his kind support, but at present I do not want to reinforce my theory by imaginary forces emanating from the interior of the Earth. We should, I think, first try to exhaust the possibilities of the forces acting on the surface about which something definite can be known. And since these forces are capable of controlling the tremendous movements of the solar system and causing the circulation of the oceans and the air, I do not see why they should not be found equally capable of causing the incessant circulation of the Earth's crust. It must be remembered that

though I suppose mountains to be raised up by this means, this will always be balanced by corresponding subsidences elsewhere. As regards Dr. Evans's block of granite, I only claim that it would sink if it formed part of the débris in a natural depression, which I suppose to be an already overloaded and sinking area. I also think that the circulation in high mountain regions takes place only a very few miles below the surface.

I will, however, readily admit that the details of my theory cannot pretend to be at all perfect or complete in their present initial stage. For instance, Sir Gerald Lenox-Conyngham expressed his difficulty in believing that deposits may make a depression deeper or that heights may become higher by reason of erosion. I can at present do no more to make the idea plausible than is indicated in section 7 of my lecture. I think the mere challenging of the long-established idea of "blanketing" is a big step forward, and that the section does at least indicate the possibility of a full and complete explanation being attainable.

I should like to deal further with many of the difficulties that have been raised, but I think it is more important to urge that imperfections in the details of my theory are really minor issues at the present moment. The important questions are whether heights do actually grow in the face of erosion, and whether the greatest deeps on coasts and rivers do correspond with the areas of maximum deposit, and generally whether my theory is capable of giving a coherent explanation of the facts. In a matter of this magnitude the main idea must first be sketched out before the necessary variety of specialists can combine to work out the details of a perfect theory. The idea that the sun was at the centre of the solar system had to wait generations before it could be properly explained by the laws of gravity; and in the meanwhile it had to win its way to acceptance on the bare grounds that it was the only coherent explanation of all the facts. I therefore feel that all theoretical difficulties will be set right in due course if only my main idea is found capable of explaining the facts of physical geography in detail. For if it can do that it can do more than any current theory is able to attempt. So that all geologists will gradually begin to use it for their field work, just as they are now using principles based on an indeterminate mixture of theories far more imperfect and incoherent than mine.

I therefore urge that my theory should first be judged by its practical power of explaining the facts. Up to the present moment I am the only person who has had any real chance of seriously testing it in this respect, and I wish I had time to give you many more examples of its agreement with the main facts of the Earth's surface. However, I have challenged many facts this evening, some of which can be tested without much difficulty; and for the rest I can only say that the more I have tested the theory against a great variety of facts the more convinced have I become of its ultimate power to explain them all. I therefore venture to prophesy that those geologists and specialists who are the first to improve the theory and apply it to their own line of work, will find themselves the pioneers of the New Geology of the twentieth century.

For myself I can only pose as the explorer who has lighted by a happy chance on this new and untried way through the mazes of physical geography, and who is now trying to indicate its possibilities which he alone has seen. I cannot pretend to be an expert in regard to the more recondite points of geology, chemistry, and physics, which enter into this problem. But whatever the imperfections of my attempt may be, I do feel that I am at least pointing in the right direction. And now, having done that to the best of my ability,

I can await the issue with confidence, feeling sure, as I do, that in due course the right men will rise up to throw the light of their wider knowledge in a direction which I can only indicate very imperfectly at present.

The PRESIDENT : We have had a valuable discussion on a subject which must keenly interests all geographers—especially those of us who have spent much time among mountains. We cannot yet arrive at any definite conclusions. But we feel we are on the track of something which will have an important bearing on Geography. On your behalf I cordially thank Colonel Tandy for having brought the subject forward again and made so valuable a contribution towards our understanding of the principle of isostasy.

GEOGRAPHY AS A PIVOTAL SUBJECT IN EDUCATION

Sir Halford Mackinder, M.P.

Read at a Meeting held in the Map-room of the Society on Friday, 18 *March* 1921.

I HAVE come here to-day as Chairman of the Council of the Geographical Association, the dutiful daughter of this great Society, to ask for your maternal help at a critical juncture in the movement for the wider and better teaching of Geography. The Geographical Association has some 4000 members, nearly all of whom are teachers of Geography. I speak therefore not only from a personal experience of more than thirty years, but also as the representative of an organized branch of the teaching profession.

The main point to which I am going to direct your attention is that, whereas there is now a full recognition of Geography by Educational Authorities as regards both pupils under 14 and students over 18, yet Geographical teaching in the four adolescent years between 14 and 18 is starved both in respect of time and of money. In order that you may appreciate the position, it is necessary that I should trace very shortly the progress of the movement for the better teaching of Geography from its small beginning to a widespread promise. Then I will state the view of the Council of the Geographical Association that in the present condition of educational affairs it is in the power of the Board of Education by sympathetic or unsympathetic administration to reap or to blight the harvest of a generation of effort. I will conclude by expressing my view that Geography is now ripe to be a pivotal subject in coherent schemes of secondary education.

If there be an occasional autobiographical note in what I am going to say I hope you will forgive me, for I must refer to some matters *quorum pars fui.* In fact, I shall frankly draw on my reminiscences rather than attempt a detached and formal record. It was for a geographical adventure that I was commissioned by this Society just a generation ago,

and I am going to tell you an explorer's tale. I have no doubt that the experience of others here present has been parallel. *Ex uno disce omnes.*

As has been the case with other successful careers, our movement made, in the first instance, a false start down what proved to be a blind way. For a number of years in the middle of last century the Royal Geographical Society offered medals annually for competition among the boys of a few of the greater public schools, with the result that two or three boys were each year specially coached by one or two enthusiasts among the masters—notably Mr. Robinson of Dulwich—and nothing more was accomplished. It is interesting, however, to observe that with a sound instinct, as I think, the aim of those days was directed precisely to the later school years. But the entrenchments of the established curricula were impregnable to a frontal attack, and fortunately so, in my opinion, for neither the subject of Geography nor its teachers were then prepared for a principal *rôle* in education.

In the early eighties the Council of this Society began to realize that they were missing their mark, and, under the lead of Mr. Francis Galton and Mr. Douglas Freshfield, they decided to withdraw the offer of the medals and to embark on a better calculated effort. Mr., now Sir John, Keltie was despatched to the continent on a reconnoitring mission, and returned with an eye-opening report and a collection of maps and apparatus gathered from several countries, but principally from the German-speaking lands. The lead of Germany in Atlas cartography and in scientific and philosophical Geography was at that time indisputable and due probably to the military influence in German education. From the days of Humboldt and Karl Ritter there had been professors of Geography in most German universities. In this country, on the other hand, the geologists had captured Physical Geography, and had laid it out as a garden for themselves, while the remnant known as "General Geography" was a no man's land, encumbered with weeds and dry bones. Before British Geography could come into its own again it was necessary to reannex the garden and to clear and cultivate the waste. The universities were obviously the proper agencies for this endeavour.

Mr. Keltie's Exhibition of continental efficiency in the way of maps and apparatus, advertised in the newspapers, attracted my attention, for I had been caned at school for drawing maps instead of writing Latin prose. I came up to London to see it, and though he did not know his young interrogant I had the honour of asking some questions of Mr. Keltie himself. Having just graduated, I naturally proceeded to draw up a set of lectures for the Oxford University Extension, and I gave them the title of "The New Geography." After all, one of the best ways of learning a subject is to set to work to teach it! The result was that I was sent for by Mr. Bates, then the veteran secretary of this Society, and was told to write a paper on "The Scope and Methods of Geography."

Though that paper contained nothing which would surprise any of us to-day, it divided the Council of this Society into contending and indeed rather angry parties, and the discussion of it occupied two successive evening meetings—there were no afternoon meetings in those days. In that summer, 1887, the Society agreed with the Universities of Oxford and Cambridge to subsidize University Readerships in Geography, and I was appointed to Oxford—the second Reader in Geography to lecture there, the first having been the famous Elizabethan Hakluyt. At my opening lecture there was an attendance of three, one being a Don, who told me that he knew the Geography of Switzerland because he had just read Baedeker through from cover to cover, and the other two being ladies who brought their knitting, which was not usual at lectures at that time.

Curiously, the first effect of the new start was felt in the elementary schools. Growth is slow to begin in a university, and as my stipend was not very large, I threw myself into Extension Lecturing, and in three years travelled 30,000 miles and taught several thousand pupils, many of them elementary teachers and students in training colleges. We studied chiefly what Huxley had called Physiography, for the great majority of the students were not grounded either in history or natural science, and were therefore not prepared for Geography proper.

After a year or two, as the result of an alliance with the Faculty of History, my Oxford classroom began to fill with students of Historical Geography, but Physical Geography still met with a chilling reception. Two facts had become clear: first, that the organization of our universities into faculties of natural science and humane letters rendered it very difficult to enlist students for a hybrid study, half physical and half humane; and secondly, that no teaching of Geography really worthy of a university would be practicable until boys came up from school with a better grounding in the necessary rudiments. The policy indicated, therefore, was to concentrate on training a few post-graduate students who should go forth into the schools and prepare pupils to enter the universities with the geographical mode of thinking already established. With this in mind, I seized the chance of a British Association Address in 1895 to plead for the establishment of a University Institute of Geography, in which should be assembled both the physical and the philosophical teaching of the subject. My dream was realized in 1899 in the Oxford School of Geography. The University agreed to grant a Diploma to whole-time students of the school, and I was so fortunate as to obtain the late Dr. Herbertson as my principal assistant—I made an express journey to Edinburgh in order to dissuade him from accepting an American offer which had been made to him, and I took him back with me to Oxford in triumph.

About this time a step had been taken the significance of which was not at first recognized. Mr. Dickinson of Rugby had been using lantern

slides in his classroom, and wanted to organize a system of exchanging slides between school and school. The Royal Geographical Society referred him to me, and at my invitation the first meeting of the Geographical Association was held at Christ Church, Oxford. Herbertson soon became Secretary of the Association, which under his auspices flourished, and began to publish a journal, the *Geographical Teacher*.

Meanwhile the subject itself was being reshaped. Suess's 'Das Antlitz der Erde' gave a geographical turn to that department of Geology which is now known as Geomorphology. So revolutionary were his method and outlook that the Royal Society hesitated for years before awarding him a medal. Bartholomew's Meteorological Atlas, edited by Buchan, gave us in modern form the necessary apparatus for a corresponding geographical trend in what I will describe as Geophysiology. Davis in America clothed the accumulating analysis of river systems with a terminology often laughed at but none the less provocative of fruitful and systematic study. The conception of the distribution of plant and animal associations and not merely of species completed the sequence of ideas needed for a regional, that is to say a truly geographical synthesis. I believe that I was the first habitually to use the expression "regional" in this connection, but Herbertson made a further advance with it in his paper on the "Major Natural Regions of the World." If the Philosophical or Humane study of Geography lagged behind for a time that was no more than was to be expected, for that study postulates not only developed Regional Geography on the physical side, but also the application of economic and strategical ideas to the past and present distribution of human societies. Here the work of the French geographers and sociologists has been important, and notably in their different ways that of Vidal de la Blache and of Leplay. Not the least incentive to a scholarly geography in the completest sense has been the need of it as a weapon of research for the reconstruction of the early history of mankind as revealed by excavation. Perhaps without being invidious I may name my friend Prof. J. L. Myres as a pioneer in the application of Geography to this purpose. When we remember that the whole of this great academic superstructure is based on an infinite labour of surveying in the field, and that it is only within the present century that we have so far reduced the unknown areas on the globe that we can begin to generalize with a sense of completeness, we obtain some measure of the advance achieved in the last thirty years.

The results of all this work—organization, teaching, research, and writing—ripened suddenly to a harvest in the ten years before the war. Professorships and Lectureships in Geography were established in nearly all the universities of the kingdom. Competitors to the Oxford School appeared in several quarters. A place was found for Geography in Pass Degrees, and presently in Honours Degrees. Students began to flock to the classes, and no difficulty was experienced in placing the better of them

in posts, usually of course as school teachers. Text-books appeared in increasing number. A few even of the great public schools began to make Geography the specialty of one of their masters.

This was the position when the war came upon us, and then in a rudimentary sort of way the whole people began to think strategically, or in other words geographically. We who were growing old in the cause thought that when the war was over our favourite study would be permanently established in its rightful place. But as with other sanguine war hopes and forecasts the realization, although not contrary to what was expected, has not been complete. True that the classes have never been so crowded with students as at present, and the Geographical Association has never had so many members. Further victories, too, have been won in the curricula for University degrees. During 1920 there were at least ten Summer Schools in Geography in England and Wales, most of them overcrowded with students. But there is none the less a feeling of uncertainty prevalent among teachers of Geography, a feeling that the promise of a rich harvest may after all be disappointed, and a spirit, therefore, of discontent with our Educational Providence.

In plain words, it is felt that the secondary schools are the key to the position, that the curricula of those schools are passing more and more under the control of the Board of Education, that the Board in its Secondary Branch is not very sympathetic with the claims of Geography, and that it is in the power of the Board to stop advance just at the time when as the result of a whole generation of endeavour Geography and geographers have been shaped to the purpose of an efficient educational weapon. Let there be no mistake about it, if the upper classes in secondary schools are not allowed, in cases where it is so desired, to make Geography a main subject of instruction, then the University study of Geography will be impoverished for the reason that it will be impossible to exact a preliminary knowledge of students entering the classes, and still more for the reason that no adequate scope will be offered for those who graduate in the subject. Once let it be clear that that vicious circle is to be established and it will inevitably follow that the effort to improve the standard of University Geography will be relaxed, and in the long run even the elementary schools will feel the effect.

The issue of regulations discouraging to geographers began before the war. It is quite likely that there was no intention to discourage, but we have to deal with the effect. In 1913 the Board of Education (Secondary Branch) issued a Circular (No. 826), still not withdrawn, in which it was stated that "It is not necessary that separate instruction in both History and Geography should be given in all forms. In schools in which the pressure on the time-table renders it necessary, a shortened course of geography, terminating at the age of 14 or 15, may be accepted." As a matter of fact this recommendation had at first very little effect. The movement to improve Geography teaching continued in spite of it, and

more and more schools and pupils studied the subject, while the work done was increasingly valuable.

In 1917 the Board of Education (Secondary Branch) decided to encourage work in schools beyond the age of 16 (matriculation standard) by initiating what are known as "Advanced Courses" for pupils between 16 and 18. With the principle every one interested in education will agree, but unfortunately some details of the scheme as drafted have proved disastrous to Geography. It is the one and only main subject of a liberal school education, which it is impossible to take as a main subject in any of the Board's advanced courses. The consequence is that much official pressure is exercised to prevent pupils from making Geography a principal subject between 16 and 18, and the courses are too full to allow of its being taken at all adequately as an extra.

Two results follow from this. In the first place, schools naturally encourage pupils between 14 and 16 to concentrate upon subjects which will be important for them between 16 and 18, and Geography is suffering from this in a large number of schools. Time-tables are being readjusted against Geography even in schools with really distinguished teachers of the subject. This is now reinforcing the evil influence of Circular 826 quoted above.

In the second place, both by the regulations and by the early dropping of Geography, it is suggested that the subject is not of an importance comparable with that of other subjects of the curriculum, and that it can consequently be taught by teachers of a lower grade. Discrimination in detail, as regards status and salary, against teachers of geography, however qualified, is becoming widespread and dangerous.

And this is not the worst. As a result of the antagonism to Geography above noticed the subject has great difficulty in claiming any place in the "Second Public Examinations," and those universities which have recognized it here have need to act virtually in opposition to the Board's schemes as drafted by its Secondary Branch. In the case of some universities, there is undoubted feeling at what is considered the grave indifference of the Board to an essential part of the training of citizens. The case is made more serious now that Government scholarships and scholarships given by university authorities and local authorities as well, are to be awarded in ever-increasing proportion on the result of the "Second Public Examination."

The action of the Board is thus producing a situation in which Geography is to be taught up to the age of 14, but as little as possible to pupils from 14 to 18. The universities clearly wish it to be taught to students over 18, and thus have to deplore the reactionary attitude of the Board's Secondary Branch. The great point is to secure some recognition of Geography as a subject in the "Advanced Courses."

The Board did recognize, experimentally, courses including Geography at Leytonstone and at Ruabon. These courses were allowed grants on

the basis of "grants for experiments," *i.e.* £250 per annum against £400 for advanced courses. I understand that Ruabon School has now set this experiment aside and organized an advanced course with Geography in a subordinate position so as to get the £400.

The central idea of these "advanced courses" is the coherency of the subjects chosen, so that they shall form a group of such a nature as to be educationally complete. Every one will agree with this intention. What I wish to submit in conclusion is that if liberally interpreted this very idea should work out in favour of Geography and not against it. Geography is inherently not an elementary but an advanced subject. It postulates both scientific and humane knowledge. No one can appreciate geographical correlations without some mathematical, some physical, some economic, and some historical knowledge. Geography is essentially a mode of thought which has its scientific, artistic, and philosophical aspects. If our aim is to give unity to the outlook of our pupils, and to stop that pigeon-holing of subjects in their minds which has prevailed in the past, then Geography is admirably fitted as a correlating medium. It may very easily be made the pivot on which the other subjects may hang, and hang together.

Let me indicate my meaning by two or three examples. I can conceive of a very fine course for boys between 16 and 18 conducted by three masters working in harmony and teaching three major subjects, such, for instance, as Mathematics, Geography, and Greek, and two minor subjects, say, Physics and Latin. The geographical teacher would be able to assume the mathematical knowledge needed for map projections, the physical knowledge needed for the understanding of the air and water circulations, and the historical knowledge which accompanies the modern teaching in Greek and Latin. He would no doubt choose the Mediterranean for his special subject, and would fascinate his students by linking together all their studies in a concrete philosophy. To take only one other illustration, let us assume a similar combination, but with the following components—as major subjects, Chemistry, Geography, and French, and as minor subjects, Botany and Spanish. This would be a commercial course, and the geographer would be able to postulate the chemical and botanic knowledge which lie at the root of economic geography, and on the other hand such a knowledge of the Romance lands as would enable him to take Western Europe and South America for his special regions of study.

No doubt it will be urged that History better than Geography would form the pivot between the precision of science and mathematics on the one hand and the human faculties of imagination and expression on the other hand. I desire to make this point in that connection. It is obvious that neither of the outlook subjects—History which looks back through time and Geography which looks out into space—can be studied wholly apart from the other. The question before us, however, is whether our

educational perspective shall be based on History with some Geography or on Geography with some History. Now if I were asked why those who have received a university education are so frequently excelled in practical life by those whose main schooling has been won in the world, I should say that it is in no small degree owing to the sterilizing tendency of too strong a historical sense in their mental equipment. Far be it from me to depreciate the statesmanship which is based on the sense of the continuity of events in time. But what matters to the vast majority of people, who must consider to-day and to-morrow rather than yesterday, is the outcome of history as expressed in the facts of to-day, and not the process by which that outcome has been effected. Nothing is more noticeable in the present working-class demand for education, as illustrated for instance by the Workers' Educational League, than the call for economic, legal, constitutional, and geographical information. If the educated classes are not to lose their grip and their influence over the half-educated proletariat, they must strive for a sense of "actuality" in the French meaning of that word. In other words, Mahommed must be thought of as embodied in the still greater fact of Islam in the world of to-day and not merely as a romantic figure of the past. So with Buddha, and Augustus, and Charlemagne, and William the Conqueror, and Shakespeare. Now Geography in its full scope not only deals with the physical environment of human societies but also with those societies themselves, for they are geographical facts. This is the principle which I have ventured to describe as "momentum" in Geography. Geographical analysis alone is not enough to explain the greatness of many centres of urban life. You must include "compound interest" on the original geographical "capital." You may analyze the position of London, and show that it was founded on a defensible hill with a water supply in its gravel top and tidal creeks for boat-harbours, but you have only so explained a big village on the site. The financiers and merchants of the world resort to London to-day, not because of these physical advantages in the little clay plateau beside the Thames bank, but because eight million people dwell here, and there is established among them the market with the greatest "good will" in the world. In other words, however fascinating it may be to investigate the beginnings of London, we must recognize that the little streams, hills, woods, and marshes, which before the houses were built shaped the site of the city, have very little actually to do with the persistence of the London money market and entrepôt trade. It is in short an independent geographical fact that you have beside the Thames in these days a "stratum" of human beings comparable with a stratum of coal or of soil; a "deposit" of human energy, skill, and habit of working together, which it would be impossible to move to a distance without destroying. Thus the results of history are embodied in geographical facts in a manner quite analogous to the determination of the physical geography of a country by its geology. Everything depends upon the

point of view. As I said in 1887, in my paper on the "Scope and Methods of Geography," the distribution between Geography and Geology lies in this, that the geologist looks at the present in order that he may interpret the past, whereas the geographer looks at the past in order that he may interpret the present. We shall make an equally clear working distinction if we say that the historian uses Geography in order to interpret the past, whereas the geographer uses History in order to interpret the present. And I believe that the geographer's standpoint is vitally important to-day.

I have only one more thing to say. Do not let it be supposed that we geographers are asking for a "soft option" in the curricula of secondary education. By all means let there be the most stringent requirements in regard both to the qualification of the teachers and in the exaction of mental effort from the pupils. All that we are demanding at the present time is that when these conditions are satisfied the pupils and the schools which select Geography as a principal subject of education shall be under no penalty either financial or in the examinations.

REVIEWS

EUROPE

The Influence of Man on Animal Life in Scotland: a Study in Faunal Evolution.— James Ritchie, M.A., D.Sc., F.R.S.E. Cambridge: The University Press. 1920. *Maps and Illustrations.* 28*s. net.*

SCOTLAND, as a region isolated and uninhabited (so far as any evidence to the contrary exists) till after the close of the Great Ice Age; whose earliest human inhabitants arrived at a period more or less certainly determined; and whose flora and fauna have been acquired since the country was left a *tabula rasa*, has been chosen by Dr. Ritchie—who by birth, education, and his responsible position in the National Museum in Edinburgh is specially qualified for the task—as a suitable region for an intensive study of the evolution of its present fauna and flora as influenced by man's interference during the centuries he has since occupied the country.

Inasmuch as Geography includes in its survey the Earth and all that therein is, this volume may be acknowledged as a contribution, in a general way, to the science with which this Society is chiefly concerned, but its subject deals more intimately with biological problems.

Dr. Ritchie contends that its earliest human occupants invaded Scotland in the Azilian or Early Neolithic period of civilization, when the 50-foot Raised Beach (which is now part of the Carse of Stirling—a wide and fertile plain many square miles in extent) was the limit of high water. On the ridge of this raised beach, the author believes, occur his earliest relics, as kitchen middens, to which were carried the shell-fish he collected at low tide to feast upon. At the close of the Palæolithic Age Scotland, till then ice-clad and devoid of life, derived its inhabitants from the continent across the North Sea, then dry land. To these Azilians the main "inland marks of the country must have appeared almost as they are to-day"; but Scotland otherwise was a country of

swamps, low forests, fertile meadows, and snow-capped mountains, whose estuaries penetrated further inland than now; while on its plains and in its woods roamed many creatures which are strange to its present fauna. Man was not long in beginning "intentionally and unintentionally, directly and indirectly, to transform and supplant both the animal and vegetable life," through his domestication of many species of the indigenous wild mammals and various kinds of birds; through his protection of other species to supply his needs, to promote sport, or for æsthetic or superstitious reasons, as well as through his introduction of alien creatures from other lands. Dr. Ritchie traces in chapters full of original deductions—with all of which some of his readers may not entirely agree—and with a wealth of learning, the complex interaction of these factors in "changing the old Order of Nature." The indirect influence of man on Nature has been "more far-reaching and ultimately more effective in altering the aspect of the countries and of the faunas he has invaded," and from a geographical point of view no influence has been more potent in changing the physical features of Scotland than the removal of the forests intentionally or by the "act of God," the draining of the swamps, and the cultivation of the land. Dr. Ritchie discusses the resultant effects of these factors on the climate, in causing landslides, and the denudation of the hills down to the bare rock, and the greater excavating power of the rains and the torrent-made streams in winter, which carry away the soil to extend seaward the river plains and the boundaries of the shore.

This in brief is the story Dr. Ritchie expounds for his readers in this most interesting volume, handsomely produced and lavishly illustrated by maps, photographs, original drawings, and very apt and charming quotations from almost forgotten Scottish authors of bygone days. His book will be read with pleasure by many who are neither professed geographers nor biologists.

H. O. F.

The Blue Guides. Belgium and the Western Front.— Edited by **F. Muirhead.** London: Macmillan & Co. 1920. Pp. 368 + lxxx. *Sixty Maps and Plans.* 15*s. net.*

This is the third of the new Blue Guides, and maintains the high level of achievement of the earlier volumes. It must have been a difficult task to write a guide to a country undergoing such rapid transitions as are now the fate of Belgium and north-eastern France. Yet even in matters of practical detail the guide is very helpful. The introductory chapters include articles by M. J. Mesnil on Art in Belgium, and by Major-General Sir Frederick Maurice on the British Campaigns in the West. Under every place details are given of its history during the war. Nine sectional maps, contoured and coloured, cover the whole of the British Western Front. They are reproduced from the maps of the Geographical Section General Staff, and are on a half-inch scale. The numerous town plans are very clear, but a few, in this copy at least, have been marred by being folded in a damp state, which has resulted in mutual transference of the black print between opposing faces. This volume, like its predecessors in the series, is a marvel of cheapness.

Il Traforo del Monte Bianco ed i grandi Problemi Nazionali ed Internazionali di Traffico.— **Maggiore Silvio Govi.** *Con* 11 *carte a colori fuori testo e* 15 *illustrazioni.* Milano: Casa Editrice Libraria Luigi Trevisini. [1920.]

The absence of a second Alpine tunnel connecting Italy with France was one of the serious problems of the war, especially after Caporetto. Even with

the improvements carried out on the Mont Cenis line, the means of communication between the two countries proved wholly inadequate. While Lombardy is served by the Simplon and the St. Gothard, and there are four great trunk-lines leading to the Veneto as it is to-day, Piedmont still depends altogether on the Mont Cenis. A new Alpine tunnel is always a political and international question. Thus Bismarck's weight was thrown into the scale in favour of the St. Gothard in opposition to France. But France's turn has come at last, and the new route should obviously link the Val d'Aosta with the valleys of the Arc and the Durance. To effect this connection there are at least three sets of projected tunnels, under the Little St. Bernard, the Great St. Bernard, and Mont Blanc respectively. Apart from technical questions, the Little St. Bernard tunnel would tap the same regions as the Mont Cenis, with which it would therefore compete, and similarly the Great St. Bernard would prove a dangerous rival to the Simplon, and would be vigorously opposed by Switzerland in consequence.

There remains the Mont Blanc tunnel. This would not compete directly with any other. Indeed, it would take the Adriatic traffic from France, leaving western traffic to the Mont Cenis. In fact, it would feed the proposed Italian–Balkan line which will provide a through route between London—Paris—Mont Blanc—Milan—Brindisi—Vallona — Salonika — Constantinople — Baghdad — and India and the East generally. Maggiore Govi considers, of course, that the Channel Tunnel is bound to come. This new Balkan line is, he holds, nearer realization than is generally supposed. Signor Buonomo's plans have been approved and work has actually been begun in the Vojusa valley.

The Mont Blanc tunnel would connect Courmayeur with Chamonix. In fact, De Saussure proposed such a tunnel for foot-passengers and carriages towards the end of the eighteenth century, and the scheme had many supporters as against the Simplon route. Maggiore Govi goes into the technical side of the question in the greatest detail. Quite apart from its main purpose, his valuable book gives a broad comprehensive survey of the whole question of Italian post-war communication problems. L. C.-M.

ASIA

A Lady Doctor in Bakhtiariland.— The late Elizabeth N. MacBean Ross. Edited by **J. N. Macbean Ross.** London: Leonard Parsons. 1921. Pp. viii. and 160. *Portrait and Sketch-map.* 7*s.* 6*d. net.*

This little book of only 160 pages possesses a permanent value. The writer lived as a doctor among the Bakhtiari, winning the confidence of the *Khans* and their wives through her medical skill and knowledge of Persian, with the result that she gives us first-hand information as to the life, the point of view, and the changing conditions among these virile, if unstable, tribesmen. Until the middle of the nineteenth century the entire population was nomadic, grazing their flocks in the plains of Arabistan during the winter and seeking the elevated valleys of the mountains during the summer. About 1850, the *Khans* began to construct castles, and now there is a large settled population, grouped round the residences of the chiefs. From these strongholds, the neighbouring country is dominated and the peasants are ground down cruelly. The term Bakhtiari, according to the author, is generally reserved for the ruling family and their retainers, the peasantry being termed Lur. The bad old order of tyrannical barons is, however, likely to change, for the *Khans*, who posed as champions of the Constitution and of liberty, cannot indefinitely keep their subjects in a state of serfdom. To take another chapter, Dr. Ross writes strongly in favour of

polygamy under the primitive conditions that prevail, and her arguments are weighty and not easily refuted.

The Bakhtiari have sent many of their sons to Europe for education, an experiment that will have a great effect on the tribe—for good or for evil. To meet a typical Bakhtiari Khan, who had been a member of the Officers' Training Corps at school in Essex, and to be accosted in perfect English by him, was an interesting experience that befell me during the World War. Finally, we learn that Bakhtiari dislike poetry, are intensely practical, and study history with passion.

It is a subject for deep regret that Dr. Ross died of typhus while working heroically to save the Serbian nation from that dread scourge, otherwise she would surely have revisited her Bakhtiari friends and studied this powerful tribe, which has played such an important rôle in Persia during the recent struggles against absolutism, with still more fruitful results.

P. M. SYKES.

A Naturalist in Himalaya.— R. W. G. Hingston, M.C., M.B., Captain, Indian Medical Service. London : H. F. & G. Witherby. 1920. *Plates and Text Figures.* 18*s. net.*

'A Naturalist in Himalaya' appeals more directly to the zoological than to the geographical student. Captain Hingston, a most enthusiastic entomologist, possessing keen powers of observation, has given us in this book the fullest and most detailed account of the habits and life-history of numerous species in many groups of insects (especially ants, spiders, bees, and butterflies) that has perhaps yet been published. Eleven out of his fifteen chapters are devoted to insects, one to the mammals, and another to the birds which have come under his observation. The introductory chapter contains a pleasant description of the general features of the scene of the author's investigations, the delightful Himalayan valley of Hazara, a strip of British territory projecting northward into the ranges ; while his concluding chapter sketches succinctly the geological history of the region. The rocks of the Hazara Valley are mainly of Tertiary limestone. While the book is not too technical for the general reader, those who are fond of natural history will find its chapters of absorbing interest.

In Unknown China.— S. Pollard. London : Seeley, Service & Co. 1921. Pp. 324. *Illustrations and Maps.* 25*s. net.*

Samuel Pollard.— W. A. Grist. London : Henry Hooks and Cassell & Company, Ltd. [1920.] Pp. 384 + xi. *Illustrations.* 7*s.* 6*d. net.*

"Sam Pollard," as he was affectionately known to his many friends, was a missionary of the United Methodist Church to West China. There he came into touch with the aboriginal tribes of Nosu and Miao who inhabit the mountain regions where meet the three great provinces of Yunnan, Szechuan, Kueichou. Braving perils in the wilds, enduring intolerable hardships, suffering treachery from villainous enemies, robbed, half drowned, cruelly beaten almost to death, he pioneered his winning way into the hearts of Chinese and aborigines alike. Something of his story he told in his little books, 'In Tight Corners in China,' and 'The Story of the Miao.' Later he was induced to write the above book on the Nosu, 'In Unknown China,' but long before it saw the light, the scourge of that region, typhoid fever, destroyed his frail body, and thereby wrung the hearts of many thousands of the aborigines who had learned to love him and to look up to him as a father.

Mr. Grist, who had been his colleague in China, has written this life of a cheery, courageous, saintly soul, and has done his work admirably. It is a

fascinating story, and throws much light on the character and condition of the aboriginal tribes, the lordly Nosu, and the oppressed Miao. Mr. Grist records that the Nosu—generally known as Lolos, a term they abhor—"have a tradition that their ancestors came from Tibet and found Chaotong plain occupied by a dark small-statured race dwelling in caves. Many of the earthen mounds on the plain are thought to be connected with the Yao-ren of a previous age. When uncovered these mounds have been found to contain rough stones and burnt bricks marked with a peculiar pattern. The warlike Nosu are reputed to have driven the Yao-ren into Szechuan, although the Chinese say that the Yao race are the same people as the aborigines in Kwangtung. D'Ollone found traces of these Yao in the north of Yunnan, and maintains that they are the men whom he had observed in Tongking. The bearing of such ethnographical discoveries is obvious. "Certain tribes of French Indo-China are evidently representatives of a race which has occupied enormous tracts of territory, and which, according to some Chinese historians, has played an important part in history, and to-day, in all probability, owing to the alliance of the conquerors with the women of conquered races, they still form the basis of numerous populations." At the beginning of the eighteenth century the Manchus drove the Nosu back into the hills, and then built the city of Chaotong, exacting tribute and submission from the scattered fragments of the Nosu tribe.

Mr. Pollard's own book 'In Unknown China' gives us more information than we have heretofore possessed. The book is a narrative, told in graphic and entertaining style, of his adventurous first journey into Nosu land, but it is enriched throughout by knowledge acquired in later years. Except in a general way the book cannot be said to add greatly to geographical knowledge, but its description of the people, their physical and intellectual character, and their language, manners, and customs, is a contribution of real value to our knowledge of the Nosu, who, with the Miao and other aborigines of West China, number many millions. The Nosu chiefs maintain a feudal system, each chief (t'u mu, "earth eye") having his own territory and defences, his freemen and serfs, who are required to perform services for their holdings and to keep themselves always fit and ready for fighting, which seems to be the normal condition of affairs, as the vendetta is the universal duty of a chief.

Unlike the Chinese the women, both Nosu and Miao, mix on equal terms with the men. Their frank, unsophisticated bearing is a noticeable feature of social life. Religion is in the animistic stage, and the medicine man, or "wizard," is medium, exorcist, and priest. The people live by agriculture in its simplest forms, and by hunting. Their staple food is oatmeal, barley, and maize. A man when travelling takes a bag of oatmeal over his shoulder and eats it raw mixed or washed down with cold water. Some are said to eat two pounds each at a meal, and on this are able to travel three days' journey without another meal. A bag of oatmeal for food and a felt cape for warmth, the cape serving as a coverlet at night, equip a Nosu traveller for any journey, even in the snows of winter, and Nosu land begins its elevation at 6000 feet above the sea.

As to ethnological distinctions amongst the tribes, Mr. Pollard says, "One is bewildered when one first attempts to classify all the tribes of Western China. Long inquiry, however, has led one to simplify them all into two or at most three races. I should divide all these peoples into Nosu, Miao, and Shan. The Shan dwell in the western parts of Yunnan and spread into Burma. The Nosu are all over Yunnan, in the west of Szechuan and in a small part of

Kweichow. The Miao are found all over Kweichow, in some parts of Yunnan and in a few places in Szechuan. Nearly all the tribes one meets with in these three western provinces can be divided into these three classes. One bases this division partly on similarity of customs among the different branches of the same class and partly on evidence furnished by the languages spoken by the various tribes. The Nosu and Miao languages stand in one class and the Shan in another. In nearly all words of the first class the vowel ends the word. . . . These two languages are thus similar to the Japanese, where the same rule prevails. . . . This fact may strengthen the very reasonable idea held by some, that the Japanese race originally came from the east coast of China, where centuries ago the Miao races predominated." He might have added that scattered tribes of them are still found near the coast in Chekiang.

Mr. Pollard gives a number of Nosu words showing the native script and the sounds. The reviewer has repeated these sounds to a Burmese scholar, who was astonished at the close resemblance of many of them to the same words in his own language.

These two books should certainly be read by all who are interested in the aboriginal inhabitants of China, and by those who love adventure.

W. E. S.

AMERICA

Cape Cod and the Old Colony.— Prof. Albert Perry Brigham. New York: G. P. Putnam's Sons. 1920. Pp. xi., 284. *Map and Illustrations.* $3.50.

The sickle-shaped peninsula sticking out on the east coast of the United States, in a latitude about one degree north of that of New York, forms a sufficiently striking feature to rouse some curiosity, but it is of course its historical associations that have begotten so much interest in it on both sides of the Atlantic. The volume now under review, to which, by the way, is prefixed a graceful inscription to the memory of the late Prof. Herbertson, "loyal friend, teacher and inspirer of many, creative thinker in the realm of man's relation to the earth," is one of those brought out to celebrate the tercentenary of the landing of the Pilgrim Fathers on the shores of America. This interest is naturally keener in America than here, which no doubt accounts for the fact that some things about which we on this side would like to have precise information are apparently looked upon by Prof. Brigham as too familiar to need mention. Thus we are told that it was at Provincetown that the passengers of the *Mayflower* landed, but we have to go to other sources to learn that this landing took place on November 11, O.S., 1620; to other sources also for any particulars about the monument which forms the subject of the frontispiece. The volume is a very attractive one both in its text and its numerous illustrations. The text, after giving an account of the settlement of the pilgrims, has two chapters devoted to the physical history of the Cape, one containing theories of its origin, and the other describing changes going on at the present day. The remaining chapters speak mainly of the human history of the Cape, including of course a picture of the life of the people as they now are, when Cape Cod is chiefly known as a restful holiday resort and as one of the chief seats of cranberry-growing in the United States. No one is better fitted than Prof. Brigham to convey to us a sense of the charm of the Cape in the first of these capacities, or to entertain and instruct the reader by suggestions of a wider outlook in setting before us the details of a tiny American county, for Barnstable County which comprises the peninsula is one of the smallest in the United States. He tells us that the first colonists experimented with communistic culture and came close to starvation. "They learned that even

the stern principles that brought them over the sea could not fully control their human qualities, and that some would be lazy if they did not work with the lure of private ownership" (p. 14). In speaking of the cranberry harvest he says that not only is hand picking almost abandoned, but the smaller scoop as well. "The big scoop might seem wasteful if we did not take account of the time and cost of labour. Several barrels of berries may be left on an acre. . . . But the market value of these left-overs would be far exceeded by the cost of rescuing them" (p. 155)—one of many reminders that in the production of raw produce it is not so much the yield per acre that is the important thing as the amount of the return for a given quantity of labour. The larger that return the greater the amount of time left for other work or for wholesome leisure.

G. G. C.

AUSTRALASIA AND PACIFIC ISLANDS

Among the Natives of the Loyalty Group.— Mrs. E. Hadfield. London : Macmillan & Co. 1920. *12s. 6d. net.*

The three larger, and a few smaller, islands of the Loyalty group, lying some 30 miles north-east from New Caledonia, of which geographically and politically, though not anthropologically, they are a dependency, are perhaps less known to the general public, and even to the Hydrographic Department, than any other group of equal importance and comparable history. Discovered either from the *Walpole* in 1800 or from the *Britannia* in 1803, but first seriously examined by Dumont D'Urville in 1827, these islands were annexed in 1853 by France at the same time as the adjacent and very much more important island of New Caledonia. Long before 1853 they had been the resort of British and other sandalwood traders ; and in 1841 a Protestant mission station had there been founded, by Mr. Buzacott, of the London Missionary Society, from Raratonga. A French Roman Catholic mission was established soon afterwards, with the usual result of violent rivalry, for ecclesiastical and even civil power, between the two sects. The French, having annexed the islands and having undertaken to establish civil administration in the purely native community, naturally supported the Roman Catholic mission, though after a time the English Protestants were allowed to resume their functions, but as on French territory.

The Loyalty Islands, so near to New Caledonia, which till recently was mainly a convict station, and so far on the direct way thence to the New Hebrides, which offered a convenient refuge to many of the escaped or released French convicts, were visited by few white men, with the exception of the missionaries and a very few French officials, of a kind to facilitate the work of the missionaries in the civilization of the natives.

Mrs. Hadfield, long resident, as the wife of a missionary, in these secluded islands, deals in no way in the book under notice with the history or politics of the group, but has made a very useful addition to their anthropological geography. She makes no claim to being a scientist ; and her book cannot be ranked anywhere near the very valuable account of the Loyalty Island folk published by Mr. Sydney Ray in the *Journal of the Anthropological Institute.* She, however, records well and simply the "yarns" which she heard from the lips of some of the older natives, when sitting with them on their mats, round the burning logs which represent domestic hearths in the native huts. She has thus supplied much welcome material from which such men as Mr. Ray may hereafter, even when such traditions have been forgotten in the islands, draw further to elucidate the many problems of geographical as

well as anthropological interest which are connected with the obscure history of the original diffusion of the natives through the islands of the South Seas.

The locality where Mrs. Hadfield has gathered her material is especially important for this purpose, in that the Loyalty Islanders are of Polynesian stock, whereas the New Caledonians are Melanesians, and the Fijians, in the nearest group to the westward, are a curious mixture of folk belonging to both of the stocks just mentioned. For example, the very curious imitation rat which the Loyalty Islanders make of a special cowry-shell with a wrought stone weight of special form, and which they use as a bait for catching cuttlefish (octopods), has been met with, together with some variation of the yarn by which the natives explain it, in Fiji and Tonga, in Samoa, and probably in many other South Sea Islands. Examination of the distribution of the practice should throw at least some small additional ray of light on the large and intricate question on the spread of Polynesians through those seas.

The illustrations to Mrs. Hadfield's book are excellent, and the index is adequate. E. im T.

GENERAL

Fifty Years of Travel by Land, Water, and Air.— F. Hedges Butler. Pp. 422. London: Fisher Unwin. 1920. *Illustrations.* 21*s. net.*

Mr. F. H. Butler is well known in many walks of life, and not least as a pioneer motorist and as founder of the Royal Aero Club. But in this volume he has essayed too big a task, in trying to crowd into a few hundred pages the rambling reminiscences of his varied experiences of land, sea, and air travel in many parts of the world. In parts it is little more than an itinerary with a few stray notes. The fullest chapter, which is on Lapland, is mainly a summary of a volume on that country which the author published a few years ago. The accounts of several visits to Rheims and vicinity during the war give vivid sketches of life behind the battle line. But the only valuable chapters in the book are those on early motoring and ballooning. They have historical interest and might well have been made the basis of a volume. As it stands, the book must have afforded the author much pleasure in writing, and will recall to him and his friends the episodes of happy years, a quality enhanced by the numerous illustrations, most of which emphasize the personal note.

Macmillan's Graphic Geographies. The British Empire.— B. C. Wallis. Pp. 32. *Map and Diagram.* London: Macmillan & Co. [N.D.] 1*s.* 6*d. net.*

A survey of the British Empire in thirty-two pages is an undertaking that a less courageous writer than Mr. Wallis might shirk, especially when the survey is historical as well as geographical. Parts of this pamphlet are instructive, but others necessarily suffer from extreme condensation. In the preliminary survey of the frontiers of various parts of the empire, Malta should hardly be mentioned as "one of the most important ports of call for ocean liners in the world," and St. Helena should not be noted as an Admiralty station. The statement that the Solomon Islands have plantations worked by whites is somewhat ambiguous. On the whole, however, Mr. Wallis has successfully stressed points of importance, and the book is well illustrated by some admirable black-and-white maps as well as several coloured maps. Some of the questions in the test exercises show freshness and ingenuity.

R. B.

The Groundwork of Modern Geography.— A. Wilmore, D.Sc. London: G. Bell & Sons. 1920. Pp. xvi. + 396. *Illustrations and Diagrams.* 6*s. net.*

It is rare to find a text-book on this part of the subject so trustworthy and useful as this volume. Dr. Wilmore has successfully escaped most of the pitfalls which await the writer of school books in geography, and moreover has produced a book which is essentially geographical and not a mere collection of scraps of general elementary science. The first and largest section deals with structural geography, the second with climatic geography, and the third with biological geography, including the distribution of plants and animals of economic importance to man. On the whole the allotment of space is sound, since no useful geographical understanding can be gained without a physical basis. The third section is rather brief, but it is questionable how far the wider issues of "human geography" can profitably be discussed at the school stage, at any rate before much regional geography has been studied. Two criticisms are suggested. The distribution of the mosquito and tsetse-fly should be discussed, since probably no forms of wild life have a greater influence on human fortunes. Secondly, the brief, almost laconic, summary of the mental traits of "the four commonly accepted races" might well be omitted; they are misleading generalizations. The illustrations are excellent.

R. B.

THE MONTHLY RECORD

THE SOCIETY

Medals and Awards, 1921.

HIS Majesty the King has been pleased to approve the award of the Royal Medals as follows: The *Founder's Medal* to Mr. Vilhjalmur Stefansson for his distinguished services to the Dominion of Canada in the exploration of the Arctic Ocean; the *Patron's Medal* to General Bourgeois, Senator for Alsace, Membre de l'Institut, for his long and eminent services to geography and geodesy as Director of the Service géographique de l'Armée, and President of the Conférence Internationale de la Carte du Monde au Millionième.

The Council have made the other awards of the Society as follows: The *Murchison Grant* to Commandant Maury, for his surveys in the Belgian Congo; the *Back Grant* to Miss Marion Newbigin, for her contribution to geography, particularly of the Balkans; the *Cuthbert Peek Grant* to Captain J. B. L. Noel, for his reconnaissance of the eastern approaches to Mount Everest and other geographical work; the *Gill Memorial* to Lieut.-Colonel M. N. MacLeod, R.E., for his contribution to the theory of survey from air photographs.

EUROPE

The Port of Paris.

An illuminating study of the Port of Paris, bringing out within small compass the main facts of its historic development, the system of waterways associated with it, and the character of the traffic maintained, is given by Prof. Demangeon in the *Geographical Review* for November 1920. From the earliest times the fortunes of Paris were intimately bound up with the Seine, whose valley formed one of the highways of commerce from the Mediterranean to North-West Europe. Later, the river contributed materially to the development of Paris, whose "water merchants" were among its richest corporations.

For hundreds of years the Seine supplied Paris with food-supplies and construction materials, and though its *rôle* in this respect became of less importance with the improvement of roads and construction of railways, its port continued to grow with the growth of the city. Three separate sections have in time become merged to form one extensive system. (1) The Seine within the city is in great part lined with wharves and quays, extending on the two banks over more than 14 kilometres, all used more or less for the unloading of building materials, while each group specializes in some particular article. (2) With the growth of Paris away from the river, canals were made which in turn became lined with wharves and also supplied a lateral communication between the Seine above and below the city. (3) The third section developed both above and below the town, chiefly to supply the factories shifted outwards from the centre to the suburbs. As a waterway the Seine is notable among French rivers for its tranquil steady flow, rarely suffering seriously from drought or floods and little impeded by sandbars or gravel banks, so that it is an invaluable artery of commerce for the whole of its region, while the small height of its bordering elevations made it easy to connect it by canals with other basins. Gradually, too, the river itself below the city has been deepened and provided with locks, with a resulting great impetus to traffic, and projects have been set on foot for still further improvements designed to make the port accessible for sea-going vessels (see *Journal*, vol. 37, p. 446). Above the city, the projected canal from the Marne will not only lessen the risk of floods, but will open up a direct route to the sea from Lorraine and the Sarre region, avoiding the tortuous passage through the city. As a port Paris has the advantage of an unusual amount of wharfage, owing to its extensive ramifications, but modern installations for handling the traffic are urgently needed. The character of the trade of Paris is somewhat exceptional. The port is not a centre for foreign trade, nor even a focal point for regional trade, but is essentially a port for the city of Paris alone. A remarkable fact is the disproportion between the outgoing and incoming freight. The Seine brings to the city merchandise for consumption there, but the nature of the shipments has changed completely since the early nineteenth century. Foodstuffs and firewood were for centuries the principal articles of import, whereas now coal and building materials form the bulk of the traffic—more than three-fourths of the whole amount received. The greater part of the outward-bound shipments —85 per cent.—consists of wreckage from the demolition of buildings, framing from construction work, and refuse. Great changes, too, have taken place in the direction of the traffic on the Seine. As long as the river played the chief part in the provisioning of Paris, the port's chief relations were with the upper basin, with some Colonial shipments *viâ* Havre. Now, owing to the large import of coal, the arrivals at Paris are largely from the Lower Seine, Oise, and northern canals. In 1917 over 4,500,000 tons of coal went up to Paris from Rouen, the port where transhipments of cargoes are made, and which may be said to have saved France during the war. In conclusion, Prof. Demangeon asks whether the port must for ever be confined to local uses, or whether it may not in time develop into a great transhipping port.

Ice Movements in Lake Sommen, Sweden.

The effects observable on the shores of lakes due to movements of ice have engaged attention for many years, though no quite satisfactory explanation of the "ramparts" so formed had been supplied until 1884, when Dr. G. K. Gilbert attributed the magnitude of the effect to alternate expansion and con-

traction, the latter causing cracks to develop which, admitting water from below, become filled with new ice on a fall of temperature, with the result that the ice-sheet becomes continually extended shorewards. Modern observations on or discussions of the phenomenon have been referred to from time to time in the *Journal* (vol. **29**, p. 577; **32**, p. 190; **35**, p. 81; **38**, p. 79), and the series is now extended by an interesting paper by Dr. Axel Hamberg in the *Bulletin of the Geological Institution of the Univ. of Upsala* (vol. **16**, pp. 181–194). After referring to previous discussions, including that of the Swedish geologist Gustafsson in 1902, Dr. Hamberg describes his own observations early in 1919 of ice-movements on Lake Sommen. This had frozen on 28 December 1918, and by March 1 the ice was 28 cm. thick. From February 21 on, the writer took careful observations of the encroachment of the ice on the shore by means of pegs fixed on the latter as well as on the ice. The principal movement took place between February 28 and March 11, by which date the encroachment in a direction at right angles to the shore had reached a total of 34·6 cm., and by March 17 it had increased to 40·7 cm. A lesser displacement parallel to the shore was also observable. Observations taken for a few days both morning and evening showed that the great pushes occurred during the day. The amount of movement is shown to be about that which the theory required on the basis of the observed temperatures and the linear coefficient of expansion of ice. The effects in the direction of piling up the loose material on the shore were less than have been observed elsewhere, perhaps owing to the smaller thickness of the ice. The piling up of the ice itself amounted in places to several metres, whilst in front of rocky shores it was bent upwards even at right angles. Folds were sometimes formed at some distance from the shore, and Dr. Hamberg also observed the formation of transverse ridges (Swedish *råkar*)—narrow zones of crushed and piled-up ice extending across the lake. They show that in a lake of complicated shape the expansion movements originate from several different centres. Such phenomena have not been observed in the extreme north of Sweden, no doubt owing to the northward decrease in the daily amplitude of temperature. Even in southern Sweden this is much less than in the more southern latitudes and more pronounced continental conditions under which the phenomenon has been observed elsewhere.

ASIA

Mount Everest Expedition.

The organization of the expedition is now complete, and all the members proceeding from England have left for India. The leader of the mountain party, Mr. Harold Raeburn, sailed from Birkenhead direct for Calcutta on March 18. Colonel Howard Bury, Chief of the Expedition, left Marseilles for Bombay on April 9, and Mr. G. H. Leigh Mallory, one of the young climbers, sailed from London direct for Calcutta on the preceding day. Mr. A. F. R. Wollaston, surgeon and naturalist, left Marseilles for Bombay on April 16, and by the same boat Mr. G. H. Bullock, who had been selected at the last moment to replace Mr. George Finch, who was unfortunately, owing to ill-health, unable to take part in the expedition this year. These gentlemen, with Dr. Kellas, who is already in India, complete the party of six from this country who will make the reconnaissance, and will, if conditions are favourable and the reconnaissance has clearly revealed the best route, make an attempt this year to reach a considerable height on the mountain. The survey operations will be entirely in the hands of the Survey of India, and we learn from the Surveyor-General that Major Morshead and Captain Wheeler were under

orders to leave Darjeeling about April 1 to carry forward a good triangulation on to the plateau of Tibet with a view to the ultimate determination of the deviations of gravity north of the Himalaya, the question of the first importance to Indian geodesy. At the request of the Government of India an officer of the Indian Geological Survey will also accompany the expedition. The Commander-in-Chief in India, Lord Rawlinson, has responded very kindly to the request that he should assist the expedition by the loan of transport, and a letter has been received recently from the Quartermaster-General detailing orders which have been issued for the selection of trained mules and their accompanying personnel. The transport train was to have assembled at Darjeeling on May 12, and the value of this assistance can hardly be overestimated.

At a recent party at Buckingham Palace the President was summoned both by the King and Queen to give them the latest news of the organization and plans of the expedition, and His Majesty has graciously shown his kind interest in the project by contributing the sum of £100 from the Privy Purse to the expedition's funds. The Chief of the Expedition, Colonel Howard Bury, was received before his departure by H.R.H. the Prince of Wales, Vice-Patron of the Society, who, with the Duke of York, spent an hour in examining the plans of the expedition, and expressed his keen interest and good wishes for its success ; an expression that was followed almost immediately by a generous contribution of £50 to the funds of the expedition.

As a result of the appeals made by the President of this Society and the Alpine Club a sum has been collected which is approximately sufficient for the work of the first season, but leaves little reserve. It is, therefore, greatly to be desired that all Fellows of the Society who are jealous for the success of the first important enterprise undertaken since the war, should, if they have not already done so, send subscriptions according to their means to the funds of the expedition.

AFRICA

The Economic Position in Marocco.

A valuable report on the 'Trade, Industry, and Finance of Morocco' was issued last year by the Department of Overseas Trade. The larger part naturally refers to the French Protectorate and affords interesting evidence of the progress made in the direction of economic development in the comparatively short time since the inauguration of the Protectorate, in spite of all drawbacks caused by the war. The most striking progress is perhaps that in the development of the system of roads. When the war broke out, one road only, from Casablanca to Rabat, had been made, but under the energetic impulsion of General Lyautey the making of new roads was prosecuted so vigorously that a network now extends all over the Protectorate in every direction. The only railways have hitherto been 60-centimetre military ones, but work on the normal gauge Tangier-Fez line (international) has been proceeding for some time, and the Protectorate Government has begun work on the Casablanca-Petitjean section of the general railway scheme now being studied ; it will eventually be continued to Marakesh. The principal port, Casablanca, suffers from serious congestion, and it is to be regretted that Safi, with the deepest and best anchorage on the coast, capable of handling up to 1400 tons of cargo per diem with no mechanical equipment, has been unaccountably neglected of late. The agricultural resources include the usual cereals and seeds, and experiments in flax and hemp cultivation have given promising results. The mineral resources are still undeveloped, and but little is said about them, beyond the

statement that oil-fields and phosphate beds are likely to be worked before long. A recent rapid advance in industrial development is noted. Large flour-mills have been erected in the main centres, and there are also saw-mills, oil-mills, cement and stone-crushing works, vegetable fibre factories, and various other undertakings. The export trade is now returning to normal conditions, though an embargo is still maintained on the export of cereals, but will be gradually relaxed. The report on the zone of Tangier shows that though the total trade has largely increased in value, the increase in quantity is but small. The United Kingdom has been outstripped by Spain as regards certain articles of import, though she has maintained the lead for others, and in some has gained the lead from France. The port of Tangier is an open roadstead and there is no prospect of early improvement in the facilities for handling cargo. The natural resources of the zone are entirely agricultural, but the production does not meet the requirements. Progress in the Spanish Protectorate has been greatly hindered by the disturbed state of the country. The presence of iron, copper, lead, silver, and other minerals has been demonstrated in many parts of this zone, and the report enters at some length into the prospects of exploitation. At present only four mines are being worked on any scale, all in the neighbourhood of Melilla. The soil is of a quality to promise a good future for farming and stock-breeding, but the indolent character of the natives has kept such activities in a backward state. There are extensive pasture lands and the soil of the "tirs" land is clayey and wonderfully fertile. It is somewhat surprising, however, to read that in these lands the harvest may fail entirely, while the less fertile "hamri" lands and the still poorer and sandy "sahel" always give some return. In spite of the generally abundant rainfall, irrigation could be introduced with advantage, particularly in the basins of the Muluya and the Lukus. A useful map shows roads and railways and the distribution of natural resources.

GENERAL

Climatic Cycles and Biological Evolution.

In a lengthy study, published in the *Geographical Review* for December 1919, Dr. Griffith Taylor reviews multifarious geological, climatological, and palæontological evidence which has led him to the conclusion that the history of the Earth reveals cyclic climatic variations of a twofold character—a major cycle of enormously long period (100,000,000 years) and a minor cycle of relatively very short period (200,000 years). The minor cycles are superimposed upon the major cycles, of which three can be recognized since Proterozoic times, in such a manner that in each major cycle after long ages of fairly uniform climate throughout the world a zonal disposition of climates is established, such as is in evidence at the present time. This zonal arrangement was most prominently developed at the four great ice-epochs in early Cambrian, Devonian, Permian, and late Tertiary or Pleistocene times. In the million years which are thought to have elapsed since the beginning of the Pleistocene, four well-marked "Ice Ages," each about 100,000 years long, separated by a number of milder "Interglacials" about the same length, have left their record, and our present climatological position is designated as the "fourth interglacial of the Pleistocene." It is argued that the more momentous epochs in the evolution of life have coincided with the stimulating zonal climatic periods, the Cambrian marking the dawn of an infinite number of new forms, the Devonian giving birth to the vertebrates, the Permian to the mammals, and the last or Pleistocene "glacial thrust" developing man whose

origin is traced in a series of migrations from Central Asia. In regard to the causation of Ice Ages, Dr. Taylor agrees with Humphreys and Brooks (see *Journal*, vol. 56, p. 146) in showing that extensive mountain-building has synchronized with excessive volcanic activity, though he considers that it is not so much that crustal activity has engendered the northern glaciation as that both were effects of a common cause. For the more recent geological epochs he attempts to estimate the mean temperature of lat. 50° N.—in which the south of present-day England lies—and of lat. 30° N.—the region of ancient civilizations—with suggestions also for the equatorial belt. In the second and most severe Ice-Age of the Pleistocene the temperature of lat. 50° N. was only 35° Fahr. instead of the present 50° Fahr., that of 30° N. was 60° Fahr. in place of the present 76° Fahr., whilst in the warm climate of the Eocene it was as high as 76° Fahr. in 50° N., but not greatly different from the present in the lower latitudes. As an explanation of uniform non-zonal epochs of climate, the writer suggests that the circulation of the atmosphere was then more vigorous than during the zonal periods, with the effect of equalizing the distribution of heat over the globe. This is by no means convincing. Moreover, it is dangerous to form quantitative estimates of climatic change on the basis of biological evidence, for it is surely possible that in the course of ages particular species may vary in their susceptibility to environment. Polar coal and coral no doubt signify milder conditions in the distant past, but the extent of the change can hardly be laid down on such evidence; and it is unsafe to assume, as does Dr. Taylor, that because a certain flora flourished in France during the Pliocene, the country must necessarily have been *five* degrees warmer than now.

The Egerton 1513 Atlas in the British Museum.

In his interesting article on this Atlas in the April number, Mr. Abendanon appears to have overlooked a point, which might prove at once that the Atlas cannot date from before 1541 *at earliest*. This is the naming of the "Grande riuiere des Amazones," which surely shows that the Atlas must have been made after the voyage of Orellana down the great river, completed in 1541, during which it received its present name. In saying that the draughtsman of the Egerton 1513 Atlas may have been the "inventor of the South Continent" it is to be presumed that Mr. Abendanon is thinking only of the French maps of the Desceliers—Desliens type. The Southern Continent had already figured conspicuously in various earlier maps, including the globe of Robert de Bailly of 1530, the heart-shaped maps of Finaeus and Mercator (1531 and 1538), and had appeared in one form or another in Schöner's globes of 1515, 1520, and 1533.

Bamboo for Paper-making.

The search for new sources of supply of various necessary commodities has been speeded up in many directions by the conditions arising from the war, and in no case perhaps are such new sources more needed than for paper-making. Even before the war the threatened diminution of wood-pulp supplies made the question an urgent one, and the possibility of finding substitutes within the British Empire was discussed in 1915 in a paper read by Mr. S. C. Phillips before the Society of Arts (see summary in the *Journal*, vol. 46, p. 160). One of the materials there spoken of as yielding promise of good results was that obtained from bamboo, and the present position in regard to this is now sketched in an instructive article in the *Bulletin of the Imperial*

Institute. The opinion is expressed that the manufacture of paper from bamboo is likely before long to be undertaken on a large scale in several countries. Steps have already been taken to utilize the supply for this purpose from Trinidad, Burma, Madras, and other parts of India, and well-equipped paper factories have already been started in Indo-China. Paper made entirely from bamboo pulp is said to be of high quality, suited for the better grades of printing paper.

OBITUARY

Fred. C. Cornell, O.B.E.

WE very much reget to record the death of Mr. Fred. C. Cornell, whose paper on "The Lower Reaches of the Orange River" was published in the last number of the *Journal.* Those who had the pleasure of hearing his lecture before the Society on 24 January 1921 will long remember his striking personality and excellent style of narrative. He had quite recently made the story of his mineral prospecting in South Africa into a book, 'The Glamour of Prospecting,' which will stand as a very interesting account of that side of his life. But he tells little or nothing of the services he rendered to the Empire through the Boer War, the Rebellion in 1914, and the campaign against the Germans in South-West Africa. His tragic death as a result of a motor accident while on a brief visit to this country is deeply to be regretted, and all who had the pleasure of knowing him will sympathize deeply with the widow and seven children he leaves.

CORRESPONDENCE

Mapping from Air Photographs.

I READ with much interest the article by Lieut.-Colonel S. F. Newcombe in the September number of the *Journal* on mapping from aeroplane photography. The methods he describes are practically the same as those made use of in Mesopotamia from 1917 to 1919 when I was responsible for the mapping of about 2000 square miles of country and some twenty town-plans from aero-photographs. I would point out, however, that the information regarding the Baghdad map derived from Captain Cole is not accurate. A description of the compilation of this map was submitted to the War Office and to you in September 1917 and acknowledged in your letter dated 15 November 1917. We found that for practical purposes of extracting areas, giving the correct areas of buildings, and for other revenue purposes, the adjusted mosaic is not suitable, as it shows only roof areas of buildings, and shadows interfere with the accuracy of detail ; it must be turned into a line-plan by a surveyor while actually going over the ground. As regards the mosaic replacing a topographical map, even on a large scale of 1/10,000 our experience proved that even amongst trained map-readers, very few officers could interpret a mosaic correctly. Colonel Newcombe's comparative statements of cost between "air survey by photography" and "survey on ground" are very much in favour of "Survey from the air" as compared with our experience in Mesopotamia and from experiments carried out in India in March 1920.

There is no doubt in my mind that in future the detail of town-plans will

be filled in from aero-photographs instead of from a laborious and slow ground survey, but there will be more ground work than one would expect from reading Colonel Newcombe's article. As an example of comparative cost rates I might mention an area of 9·2 square miles which was mapped from air-photographs and printed in symbols on a scale of 16 inches to 1 mile; the ground was on the outskirts of Baghdad, partly open fields, and partly intricate detail of gardens and buildings. The actual cost from air-photographs was Rs. 4169, and the estimated cost by means of land-survey based on the Survey of India cost rates of cantonment surveys was judged to be Rs. 11,700, both being exclusive of reproduction and printing.

In case it might be of interest I enclose a copy of the report on this map. [Not printed, but placed in Library.]

It must be remembered that our work in Mesopotamia was done with photographs taken under active service conditions; mapping should be greatly simplified by the use of stabilized cameras or other inventions that will ensure the optical axis of the camera remaining truly vertical. I might mention that prints of a large number of town-mosaics enlarged to a scale of 1/880 were supplied to the "Tapu" department in Mesopotamia; these were used merely as key-maps for the registration of property and buildings and no areas or measurements were taken from them; they also proved useful in laying out schemes for water-supply, electric light, and billeting, etc.

In 1919–1920 Colonel F. W. Pirrie, C.M.G., C.I.E., compiled maps from aero-photographs for the Mesopotamian Civil and Military authorities, and has kindly given the following information:—

His experience was that in cultivated areas in Mesopotamia near Baghdad aero-photographs were very useful on the scale 3 inches to 1 mile or larger. The mosaics themselves were of little use as maps unless details were identified, selected, and inked up in conventional map-form on the ground, and irrelevant matter omitted. The heights of walls, banks, and ditches could not be estimated by merely looking at the photographs, and had to be measured, and these relative heights put on the map on the ground. Very close triangulation or traversing would have been necessary unless the orientation and scale of each photograph had been tested by rays and a few actual measurements taken on the ground. The amount of ground survey varied greatly, and depended on whether there was much undulating ground, insufficiently steep to cast a shadow or appear at all on the photographs, or whether the surface vegetation was of a kind that concealed ditches and other relevant ground details. The amount of uncertainty under these heads could never be estimated or got rid of unless qualified ground surveyors were sent over the ground with the separate photographs and combined mosaic.

As regards the most suitable scales for maps compiled from aero-photographs, we found that when using the service cameras and machines the smallest scale suitable for the process is 3 inches to 1 mile; we compiled large areas of inaccessible (enemy) country on the 1 inch scale, but as the R.A.F. did not produce negatives on a smaller scale than $3\frac{1}{2}$ or 4 inches to 1 mile it required a large number of negatives to cover a small area of the map. Perhaps a safe guide for practical work over large areas would be for the negative to be on a slightly larger scale than that of the resultant map; for instance, an 8-inch lens at 10,000 feet gives a negative on the scale of 4·2 inches to 1 mile, which was found quite suitable for the compilation of maps on the 3-inch scale.

I have just read a report by Major C. G. Lewis, R.E., on an experiment in Air-Photo Surveying which was carried out by the Survey of India in March

1920. Many of the conditions were unfavourable, and the R.A.F. used a L.B. type camera with an adjustable cradle. The results seem to confirm the opinions formed in Mesopotamia that air-photography cannot at present compete with ground surveys on a scale smaller than 3 inches to mile.

The experiment in City Surveys was very interesting. The negatives were on the scale of about 1/1800 and the mosaic was compiled on the 1/900 scale; the errors due to distortions were found excessive on this scale. It would appear that under present conditions the largest practical scale is 1/1500 or possibly with negatives free from tilt distortion a scale of 1/1000. This experiment brought to notice many difficulties that must be overcome in the compilation of an accurate large scale town-plan from aero-photographs, and emphasized the fact that skilled surveyors are required for the work, and incidentally entirely refutes Colonel Newcombe's view that a trained surveyor is not necessary for the completion of even a mosaic map.

From a map-maker's point of view it is very necessary to draw attention to the many inaccuracies contained in a photographic negative and to dispel the idea so prevalent that "because it is a photograph it must be correct."

C. P. GUNTER, Bt.-Lieut.-Colonel R.E.

Bangalore, India, 22 November 1920.

MEETINGS: ROYAL GEOGRAPHICAL SOCIETY: SESSION 1920–1921

Eleventh Evening Meeting, 4 April 1921.—The President in the Chair.

ELECTIONS.—The Right Hon. Viscount Buxton, G.C.M.G.; Frank Travers Carlton; Thomas C. Glen-Coats, B.A.; The Rev. Charles Paul Cowland Cooper, M.A.; Robert Gordon Dunthorne, M.A.; Alexander S. Gillespie; Captain Henry Archibald Roger Graham; Andrew Gugushvili; George Frederick Hirst; Captain Ambrose Keevil, O.B.E., M.C.; Lieut.-Colonel M. C. Lake; Robert James Mackintosh; Austin Mardon; B. E. W. Massey; Mrs. Durie Pattullo; Mrs. Beatrice Oliver Smith; George Benson Stewart; Frank Edward Tavener; George Alfred White.

PAPER: The Scenery of Greece. A. W. Gomme.

Twelfth Evening Meeting, 18 April 1921.—The President in the Chair.

ELECTIONS.—Stanwell Alfred Adeney; Vernon G. Cole; Miss Grace Freeth; Captain Ivor Hedley; Lieut. R. V. Hume; Henry Reid Lister; Hugh Penrith Morgan; Ephraim Nicohosoff; Godfrey Charles B. Parish; P. Lee Phillips; Algar Ronald Ward Robertson; Miss Winifred M. Saunders; Charles Robert Webster, O.B.E.

PAPER: South Persia and the Great War. Brigadier-General Sir Percy Sykes.

Sixth Afternoon Meeting, 11 April 1921.—The President in the Chair.

PAPER: The World-Map before and after Magellan's Voyage. Edward Heawood.

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A RECONNAISSANCE IN THE CASPIAN PROVINCES OF PERSIA

Captain J. B. L. Noel

Read at the Meeting of the Society, 10 *January* 1921.

THE Caspian provinces, owing to their isolation by the barrier of the Elburz Mountains, to their dense forests, and to their having been intentionally left with undeveloped communications for political reasons, have hitherto remained one of the least-known corners of Persia. Nor was it altogether safe for travellers to venture to those parts until a year or two ago when the gendarmerie arrived and disarmed the turbulent, feudal officers of the Shah's Mazandaran army, who spent their time fighting one another in the forests and sometimes rebelling against the authority of the Shah. The Caspian country is now again disturbed by the renewed rebellion of the Jangali tribes of Gilan.

For previous knowledge of the Caspian country we have the authority of Lord Curzon, who in his book gives a chapter of information on Mazandaran; then there is the record of the French Scientific Mission and the accounts of Mr. H. L. Rabino, *Geographical Journal*, 1913, and two German travellers. We have no proper maps of the Caspian provinces; the existing degree sheets, being drawn largely from hearsay, are more misleading than helpful. Mr. Rabino, while British Vice-Consul at Rasht, prepared a fairly good map of Gilan; and it still remains the best available of that part. It is known that the Russians had an accurate large-scale map of the coastal country, but this was secret, and has never been seen by the public. The country presents some difficulties for survey; but no doubt the survey will soon be accomplished when the political disturbances have subsided, as our mapping parties have already carried the half-inch sheets as far as Tehran. Meanwhile the accompanying sketch-map may perhaps serve to fill the gap and illustrate the route along the coast.

While at Kazvin in March 1920, Captain Fortescue and I had the good fortune to receive orders to proceed on a reconnaissance tour through Mazandaran to Gilan along the Caspian coast. A hurried departure at four days' notice had to be made; a surveyor could not be taken; and lack of time, and consequently lack of freedom of plan, prevented our

profiting fully by the opportunities that a visit to such a country could offer. Therefore this is, I fear, no very informative narrative, but only a short and simple account of a quick reconnaissance of what is certainly a most interesting country.

There is a choice of routes from Tehran. The Savad Kuh is the main caravan trading route to Barfarush and Sari, but the Harhaz road is shorter, more difficult in winter owing to snow, and the more interesting route to Mazandaran. It is 110 miles to Amul, crossing the mountains by the Imam Zadeh Hashim Pass under the shadow of Mount Damavand. From the north-east gate of Tehran a broad metalled road swings out over the plain. The mountains lie in a horseshoe around. The plain is shingle-strewn and barren, but away in the distance at the foot of the mountain slopes one sees villages prettily grouped among tall trees and greenery. The road steers straight for the great cone of Mount Damavand, king of the Elburz, and highest mountain in Persia. There is a village of the same name to which this carriage road leads. The place is a favourite summer resort of the people of Tehran, as it lies amid delightful scenery with the best shooting and fishing. The Shah's shooting preserves are in the vicinity.

One rides on over the ridge of hills to Jajarud, picturesquely set among willows and poplars on the banks of the broad river of the same name, and then climbs up a branch valley to Kermandah Serai, the end of the first stage, 18 miles from Tehran. Above Kermandah the road debouches on to an elevated rolling plateau intersected here and there by nullahs draining away eventually to Jajarud. The peak of Mount Darud, 12,600 feet, rises beyond; and along the left flank is the wall of the Elburz, at this season thickly covered in snow. The carriage road leads to Damavand village, but the track to the Imam Zadeh Pass branches up a valley to the north, leading to the village of Ah, the second stage from Tehran, right in the heart of the mountains. On the morrow we were to cross the Elburz by the Imam Zadeh Pass and drop over into the Lar valley and the Mazandaran province in the Caspian country.

The Charvadars urged an early start from Ah, as it is a long march over the pass, and it is necessary to cross before the sun softens the snow. The track, about 2 miles above Ah village, leaves the valley, climbing steeply up the hillside to the east over a preliminary pass into the Damavand valley. The col was broad, open, and thickly covered in snow. From it one looks down to Damavand village; the track does not descend, however, but winds up the hillside, reaching the summit of the final pass by a steep zigzag along a built-up path. At the summit is a serai where travellers may rest if necessary. The view to the south is a splendid open panorama of the Damavand plain and the outer ranges of Elburz with the Great Plateau beyond. To the north there is only a narrow view of mountain cliffs and a steeply dropping valley clogged in snow. The mules find a difficulty in the descent, particularly when

another caravan is met. Then one lot of animals has to step off the trodden track into the deep snow, which is liable to slip away with them down the hillside. The lateral valley descending from the pass is so confined that it is only on reaching the Lar valley that Mount Damavand is first seen. Here the great cone rises straight in front of one. The base of the mountain is immensely broad. The La Valley is rugged; and for many miles the river flows through a gorge, so the road, after crossing to the left bank, is forced to mount up on the flanks of Damavand, keeping sometimes 2000 feet above the river owing to the precipices below.

The scenery on the Caspian side has changed. There are no elevated plateaux and rolling plains as on the south side of the mountains, but the ground is rugged and precipitous, and the valleys drop rapidly to the sea. There is a police post and serai at the junction with the La Valley; but as there are only scanty supplies available, the first convenient halting-place is Rehna village, a long way down, and some 27 miles in all from Ah. Beyond Rehna, the path descends from the elevated shelves to the river-side. Some curious rock-hewn dwellings are passed, described by the natives as "sangars." This is the most thickly populated part of the Harhaz valley (Harhaz being the name of the lower Lar valley), and many villages are passed on either side of the river. Lower down there are few villages, as the ground is too rugged for cultivation. The road passes along the face of the cliffs on outbuilt galleries, well made but narrow, and a little tricky unless you are certain of your riding-horse. The pack-ponies are not worried by the precipices, and will go anywhere as long as they can get a path broad enough for their loads.

In the absence of villages one finds frequent artificial caves cut into the hillside, built as a protection against horse thieves and brigands. Animals can be shut up inside while the charvadars sleep guarding the entrance. These caves still form the regular caravan halting-places. We put up one night at the caves of Ayo, 20 miles below Rehna. There was snug accommodation in them for two hundred mules and ponies. On the next stage there were no villages except the police post at Siah Bisheh, where the officer in charge courteously turned out his men for inspection and salute and despatched a mounted man in advance to arrange everything at the next halting-place. The politeness of the people is perhaps one of the chief charms of travel in Persia. The traveller is greeted and entertained; in villages a house is always placed at his disposal; and at the serais in this valley where there are few villages one can still be comfortable, as the men bring all requirements, grain for the animals, and a steaming samovar for tea, with eggs and chupattis and a charcoal fire. The Gendarmarie under Swedish officers is well organized. You find their posts along all the trade routes, even in these wild valleys. They are always armed and ready to turn out, always smart and efficient. They have brought order and peace to the caravan roads formerly so notorious

for brigandage. The Gendarmerie seem to be on a different footing from the Cossacks or Persian army proper under Russian officers. One can only describe the Cossacks, if an alliteration may be excused, as lazy, lousy, and licentious.

At the confluence of the Nur river the Harhaz bends to the east for some miles, then bends north again and, passing through a gorge, enters the forest region above Parasp. Here, when the inland wind is blowing, one gets the first smell of the strong sea air.

It was unfortunately a little too early in the year to appreciate fully the forest scenery—such a surprise after the bare plateau land of Tehran and the barren valleys of the Elburz—as the foliage was not yet out. Where the river reached the foothills, however, the valley bore a pretty touch of spring, the meadows were carpeted in primroses and long-stalked fragrant violets, with moss and ferns among the rocks. The little town of Amul lies out some 5 miles in the plain, and remains hidden by grass and bush until one stumbles right upon it. It is a picturesque little spot, with its well-built brick houses with tiled and thatched roofs and well-laid-out streets.

From the plateau of Persia and Tehran the Caspian provinces are singularly isolated. The mountain barrier over which, partly through the nonchalance of the people and partly through fear of Russian aggression, no proper roads have been opened, effectually isolates the Caspian provinces, so much so that hitherto they have almost been regarded more as Russian than Persian territory. Indeed the Russians so regarded them, for they monopolized the country. But although monopolizing it, they failed to develop its natural resources; and they also placed a barrier against Persian or foreign enterprise. Here they extorted more, monopolized more than any other part of Persia. How the Persians feared them is exemplified in the story of the little railway from Mahmudadad on the coast to Amul, built by the enterprise of the Persian merchants to tap the wealth of the forest and rice and cotton fields, and intended one day to be extended to the iron ore deposits at Angetarud. The railway, after flourishing awhile, was destroyed by order of the Tehran Government, who feared it might facilitate Russian aggression on the distant capital. A Russian obtained the monopoly of the sturgeon fisheries and caviare making on the Persian shores for a nominal sum, the Prime Minister advising the Shah to give away the rights, saying, "The water of the sea is salted, and the Prophet has taught that the sturgeon fish is unclean food for man, so what use have we for the water and the fish?"

The isolation of the Mazandaran resulted in the central government retaining only a loose control over the people, who prior to 1919 were banded together under the leadership of three principal military officers, Sirdar Jalil, Amir Mokaram, Amir Moayat.

Mazandaran may be divided into two parts: first, the plain occupying the bay of mountains where they recede some 20 miles from the sea; and

SKETCH-MAP OF THE CASPIAN PROVINCES OF PERSIA

where lie the towns of Sari, the capital (20,000 people), Barfarush, the trade centre (40,000), Amul and Ashraf, with the seaports of Mahmudabad, Meshed-i-Sar, and Farahabad; and secondly, the hill district comprising the Nur mountains and valley, Larian (the Harhaz valley) and Savad Kuh. About half the plain—400 square miles—is cleared of forest and cultivated in rice and cotton, the two staple products of the country. Mazandaran is certainly a land of plenty, all food stuffs being exceptionally cheap. The soil is remarkably productive, growing every kind of vegetable, fruit, and flower. One needs to come to Mazandaran in the late spring and summer to see the vegetation at its best, when the fields and gardens sprout and bloom with twice the profusion of the best parts of our own country. But at that time one has to pay a price and support the one bad thing of the land : the summer climate. Typhoid and cholera ravage the population, and malaria takes its steady continuous toll of death. At that time one would prefer to escape from the disease and the steaming insect-invaded atmosphere to the hill districts. The population is divided into two groups also, the plains people and the hill people. The former remain all the year round among their cotton fields and rice swamps, earning a living easily from the productive soil and resting as much as possible in their houses. It is a man's ambition to own a village, and so live a life of ease enjoying the landlord's exorbitant but customary third of the villager's produce, remaining always in his house, eating enormously of rice and drinking enormously of tea. Very different are the hill people, who lead a healthy life in the summer among the mountains, tending their sheep and cattle, and cultivating usually only enough for their own yearly needs. In the winter they migrate to the plains to graze their cattle and earn a wage from the plains people by doing their heavy agricultural and irrigation work for them. The mountaineers are hard working, frank, friendly, and jovial. The plains people are lazy, cringing, and less hospitable.

Perhaps the most remarkable feature of Mazandaran is the forest, some 4000 square miles in area, extending over the plain, where it has not been cleared for cultivation, as an impenetrable thorny bush jungle and reaching inland from the foothills, where the giant oak, beech, and boxwood is found, halfway up to the main chain of the Elburz. The finest forest lies along the western coast, where the mountains approach the sea. The Russians have been cutting timber for years, gratis through lack of forest laws, and have exported much of the valuable boxwood to Europe. Besides the box, which grows to 18 inches in diameter, the beech and oak are the two valuable woods. There are some forty different kinds of wood in Mazandaran.

Another natural resource of the country are the minerals, of which there is evidence of considerable wealth. Petroleum is found near Sari; and it is of such good quality that the people can drain it from the ground and burn it without refinement in crude lamps. Iron, coal, and marble

are found in the Nur district; also lead, sulphur, and mineral and medicinal waters. The value of the minerals and the forests lies in their favourable geographical relation to the commercial needs of Southern Russia and the Middle East, isolated from European sources of supply. Mazandaran needs, however, roads above all things. There is not a road in the country The narrow paved paths of Shah Abbas have disappeared except for remnants here and there. The only means of travel is by horse, and the only means of transport pack mule or pony. In the summer, when the ground is dry, this may suffice, except for the obvious inefficiency of pack transport compared to wheeled transport; but in the winter the land becomes a bog, and traffic almost ceases. The road from Barfarush to Sari, the most frequented, becomes on that account the worst road in the country. A unique feature of these tracks through the winter mire are what may be named " Mazandaran staircases." The pack-ponies, treading always in the same places, cut the ground out into even corrugations or ridges at right angles across the track with water-filled hollows 2 feet deep between the ridges. Animals of the country are trained to step in the hollows, and so can ascend any slope however steep and slippery, because they walk as if up a staircase. Only the native animals are of any use either for pack or saddle, and it is a mistake to ride any horse not procured locally in the country. Furthermore, the mud is terribly injurious to horses' legs and hoofs. It was found necessary to spend half an hour after every march washing and drying the ponies' legs, and dressing them with red mercury and butter. Mazandaran is a wonderful country for its riches and its scenery, but impenetrable for travellers in winter for its quagmires and staircase roads, and impenetrable in summer for its heat, malaria, and insects. But the spring and autumn the visitor can enjoy to the full.

At Amul, as at Ashraf, Farahabad, and other places, there is much of archæological interest. Amul, destroyed three times in its history by the flooding of the Haraz, stands on the site of one of the oldest cities of Persia. The people bake no bricks for their house-building. They merely dig the soil and extract all the bricks they need. In turning the garden soil bricks and tiles appear, and digging deeper entire buildings are struck. The site of the oldest city is just north of the town. Some years ago the people used to dig regularly for treasure and obtained a good deal. In the centre of the town is the Bagh-i-Shah with the site of an ancient palace surrounded by a moat. The people have a legend of a queen's jewels lost in the sudden destruction of the town by river floods; and each Amuli hopes to strike the treasure one day digging on his property. In the Bagh-i-Shah I myself found a small wall tile covered with old goldleaf.

Amul to Barfarush is one stage; and, after a pleasant sojourn at the former place, we set out to travel east for a short way before proceeding along the Caspian shore to Gilan and Rasht.

Crossing the Babul river by a fine masonry bridge, one follows down-stream a short way over staircase and bog and reaches the town of Barfarush, a pretentious place that boasts of its 40,000 inhabitants, its trade, and its leadership of the civilization of the province. A flourishing trade certainly there was at normal times, the town being situated in a convenient position on the caravan track from Tehran to the coast. It collects cotton, which it dispatches by Meshed-i-Sar, the seaport, mainly to Baku, with rice and oranges, fresh and dried fruits. It imports sugar, tea, petroleum, cotton fabrics, clothes, and European commodities. It forwards some of these (but principally rice and dairy produce) to Tehran. Trade with Tehran is seriously hampered by lack of roads. The Savad Kuh cart road, if built, would enormously profit Tehran and all north Persia by allowing the cheap Caspian food stuffs to flow into that country, where food is scarce and dear.

Meshed-i-Sar offers a pretty panorama of thatched cottages, grouped among fruit gardens and greenery along the banks of the Babul river. The Baku steamers anchor outside the port and unload into river craft, as the bar is undredged. Riding along the coast east of Meshed-i-Sar towards the promontory of Mian Kaleh, enclosing the Murdab or lagoon of Bandar-i-Gaz, one traverses alternate marsh and forest; but the best road is the beach, a ribbon of hard sand 50 yards wide along which one can gallop for mile after mile, chasing phantom objects curious and always disappearing in the receding mirage. The ride is broken here and there by the numerous brooks and rivers that empty into the sea. The former rise from the marshes a short way inland, and these, without reconnoitring, one can generally plunge into and ford straight away. But the big rivers that come from the mountains are sometimes too deep to ford. Here horses and mules have to be ferried across in the broad-bottomed boats of the natives. It is 30 miles by the beach from Meshed-i-Sar to Farahabad, the little port that ships the trade of Sari.

For a winter's duck shooting there would be few better places than the marshes, black with duck in the season, along the seaboard; and Larim, situated in the centre of an open plain, which in the spring is a wonderful sight with its square mile of wild scarlet tulips, would be a good shooting centre. A sportsman could come to Mazandaran in the winter (if he will brave the quagmires) for a month's duck shooting, followed by a month's tiger shooting in the forests 40 miles west of Mahmudabad, where the mountains narrow to the coast, and the virgin forests of Chalandar block the way, leaving only a narrow path by which to pass along the beach at the edge of the waves; where the villagers are almost as wild as the forest itself; and where the tigers lurk in the boxwood thickets in the daytime and stroll about openly on the beach in the night-time. In the early spring the sportsman could migrate to the mountains to shoot the Caspian stag, bear, ibex, and moufflon,

driven to low altitudes by the snow. It is only in this eastern, the highest and most rocky, part of the Elburz that the hill shooting can be obtained. The fishing is disappointing, because near the sea the salmon are not of the sporting variety and cannot be fished with a rod. The natives, casting nets in the rivers, haul in half a dozen at each throw, so plentiful are the fish. The mouths of the rivers are trapped; and in the springtime, if the traps were bought off for a month, many salmon would get up to the higher reaches of the rivers, where perhaps they would take a fly. But the buying off of the traps would be a costly proceeding, because the natives catch so many fish of all kinds in them, and make a good profit thereby.

Along the shore are many fishery stations formerly belonging to the Russian Fishery Company, but taken over since the war by the Persian firm of Tomaniantz. Most of the stations, through lying idle after the Russian Revolution, have become gutted and ruined; but at Farahabad, where Tomaniantz have started their first fishing enterprise, fishing and caviare making is in full swing. Turkoman are employed exclusively in the fishing. Sailing along the coast from their own country, they settle on the Persian shores, and hire themselves out to the fishery stations, being paid by royalty on the amount of fish they deliver and the amount of caviare the fish yield. Magnificent fellows are these Turkoman, rough no doubt, but hospitable like all nomads. They invite you readily into their tent shelters, pitched always noticeably apart from the Persian villages, for whose inmates they have no great respect. The Persians of the coast fear the Turkoman because of the fierce raids they have made against them from time to time. But the raids have ceased now since the gendarmes have policed the country and protected the people by establishing posts along the coast. Still the armed gendarmes themselves are chary of arguing with Turkoman unless they are at least three to one against their unarmed visitors. Clever at their work too are these fishermen. They lay out parallel lines at the mouth of the rivers, each line carrying hanging sharpened but unbaited hooks 18 inches apart and about 2 feet deep in the water. The sturgeon, always clumsy fish, get caught by the sharp hooks as they swim upstream; and so successful is the method that each fishery station collects up to two hundred of these immense fish in a day. The Turkoman complain of losing many of their plain hooks, from which the fish can sometimes escape. They call the barbed hooks "English hooks," and lament not being able to get these any longer.

At the port of Farahabad there is only the fishery, the police post, the customs house, and the houses of some Armenians engaged in a commission agency for cotton and rice. But a little way up the river is a site of the ancient palace of Shah Abbas, commanding a bend of the river. A good deal of it still stands, and from the remains one can reconstruct in one's mind the stately form and the fine interior decorations of this

TARKOL, NUR VALLEY

BALADEH

MAIN CHAIN OF THE ELBURZ FROM THE NUR RIDGE

MESHED-I-SAR

mediæval stronghold. The domed ceilings still bear traces of their plaster and tile ornamentation. One side of the palace is vertical to the water's edge, and on the other one looks out to what must have been a beautiful walled Persian garden. Near by are other ruins, and further up the river is the present village of Farahabad.

The ride along the coast as far as this point was sufficient for a reconnaissance of the seaboard, and the inspection of the two most important seaports, for the country is uniform in character—a straight line of beach with adjacent sand dunes, coastal marshes, and further inland forest, cleared here and there for cultivation. So at Farahabad we turned back, following the same route to Amul, whence the plan was to travel west by an inland route through the mountains parallel with the coast. A noticeable feature of the Elburz is that many of its rivers do not flow straight to the plateau on the one side and to the sea on the other, but they cut long straight valleys parallel for a considerable distance with the watershed, finally breaking away to the plateau or to the sea through defiles at a sharp turn. Such a valley is that of the Nur river. One can follow the Nur valley, afterwards crossing into the Pul valley, and traverse a considerable length of the mountains by a more or less level route without the switchback work that such a longitudinal traverse of mountains would ordinarily entail. Other such valleys, splitting the mountains parallel with their length, are the Shah Rud, the Kizil Uzun, the Pul-i-Rud, and the Jaja Rud.

Travelling west from Amul, one crosses after a few miles into the Nur province, which comprises the western end of the Mazandaran plain covered with dense forests and the Nur valley, a rugged treeless region between the coastal forest and the main mountain range. From the hidden villages of the forest plain one can look straight up to the snow-covered Nur ridge 8000 feet above. Many narrow ravines lead down from the ridge to the sea. The one we took, by which to cross to the Nur valley, was too narrow to allow of a road. The ponies had to pick their way for the most part up the river-bed, travelling at an early hour to avoid the swelling of the torrent from the melting of the snow. Difficult as it was, this river-bed was the main caravan route from the Nur province *viâ* Baladeh to Tehran, even shorter than the Harhaz route, but considerably more difficult. It is astounding the ground the hill ponies can tackle with 200-lb. loads on their backs.

At Darkelah the aged Governor of Nur offers hospitality to all who visit his province. One can find much of interest in the surroundings. A day was spent in shooting pig, another in visiting Angetarud and Awuzkoti, where the natives smelt the iron ore in charcoal furnaces, and another was given up to photography. The views round Darkelah were the prettiest yet seen, particularly in the evening. One needed paints and paper rather than a camera to catch the colourings of the forest, bursting into spring greenery, the picturesque cottages of odd fanciful shapes,

leaning walls, and too big conical thatched roofs that sit on them like huge snuffers on a candle. The orange trees, peach, pear, and mulberry blossoms, the forest clearings and ricefields, where the villagers laboriously cultivate by day and the wild pigs as systematically destroy by night. The mountain wall overshadows the plain, rising 8000 feet into the realms of snow. The heavy, moist atmosphere subdues the detail of the forested slopes and dark ravines, and diffuses over the mountain background a delicate mauve-purple glow. Comparing this country with others, one might say it resembled a little the foothills of the Terai, seen in a September atmosphere at a break in the monsoon, combined with a touch of the colourings and blossoms of a garden in Japan.

The Nur ridge holds much iron ore, and one is struck by the economic possibilities when one looks back to the north. There is the sea, so close, with its shores stretching to the horizon east and west, lapping the foot of these mountains rich in minerals. The sea offers communication with the markets of the Middle East and Southern Russia. With the iron there is also coal. The only physical obstacle to mining would be the belt of forest and mountain valley between the coast and the actual location of the minerals, rather high up on the ridge. The sites of primitive native furnaces are seen in the valleys. The ore was collected from the river-beds, and smelted laboriously with charcoal to make shot and musket-balls; but now this industry has almost ceased, since the natives are allowed weapons no longer.

The ascent to the Nur ridge illustrates the rapid changes of climate and contrasts of scenery that travel in this coastal country entails. In two days you emerge from steaming malarious forests into frosty winds and snow, and change from forest scenery into the treeless landscape of the plateau once more. There are some pretty villages, however, in this otherwise desolate valley of Nur. Tarkol, the summer residence of the governor, stands terraced on the hill by the banks of the mountain brook, flowing through fruit gardens and cypress trees. Baladen, a day's march farther on, is a larger and even prettier village than Tarkol, and possesses an extensive bazaar, open in the summer months. One can climb up to the ancient watch tower on the cliff and get a good picture of the bazaar, with its houses worked one into another like cells of a honeycomb all under the same mud crust of a roof. The valley broadens at Baladeh, allowing space for fields and gardens. The river is wide and rippling before it wriggles through its gorge a mile below, the gateway from the Nur ravine to the Baladeh plain. The Elburz surrounds the place with a gaunt wall of mountains that hold the clouds blowing over from the sea. The weather here is unfortunately more often bad than good. From Baladeh radiate caravan routes over the mountains to Tehran, to the Chalus valley, to the Pul valley, and over the Nur ridge to Kurjur in the province of Tunakabun. We took the latter road, and in one day's ride crossed over to Kurjur.

Tunakabun is a smaller province than either Mazandaran or Gilan, and lies between them. It is less accessible than either the other two, as there are no good seaports and only one road, the Chalus, to communicate with Tehran. The chief town is Khurramabad in the fertile delta, called the Tunakabun plain, small compared with the plains of Mazandaran and Gilan, but nevertheless the most intensively cultivated and thickly populated part of the whole Persian Caspian coast. The cultivation is rice. In the mountains are three grain-growing districts, comparatively small also, but still so intensively cultivated that they merit being called "the granary of the Caspian Provinces." These districts of Kurjur, Pul, and Kaleh Dasht are a peculiar feature of the mountains. The valleys beneath the main range broaden out into alluvial plains at an elevation of 4000 to 5000 feet, with an area from 15 to 20 square miles. The rivers, or what is left of them after irrigating the barley-fields, continue to the sea through ravines. The province is owned almost entirely by Sipa Salar, that rich and powerful landlord who has played such an important part in recent Persian politics under his old title of Sipahdar. Sipa Salar now, however, has no military power. The Gendarmerie have disarmed the people, although not so completely as in the case of Mazandaran.

The scenery of Kurjur and Pul is not so interesting. There is no forest, and no trees except planted fruit. The terrain is one huge barley-field. Kaleh Dasht, however, reached by following down the Pul valley and crossing the deep Chalus valley, is much more interesting. Kaleh Dasht is unique. It is one of the beauty spots of Persia. It used to be the favourite hunting-ground of Nasir-ud-Din Shah, that sportsman who had a 9-foot cobbled mule road built over the Elburz so that he could come to Kaleh Dasht each year to shoot ibex, accompanied by his entire harem and the myriad retainers of the Royal Persian Palace. The plain of Kaleh Dasht, some 20 square miles in extent, is surrounded by forest and hills. To the north the ravine of the Sardab Rud leads up through pretty Alpine scenery to the foot of Tak-i-Sulaiman (height 14,000 approximately), outstandingly the second highest mountain of the Elburz; it forms the central knot, wherefrom the Nur and Lar rivers radiate to the east, the Shah Rud to the west, and the straight-flowing Chalus to the north. The mountain has a fine aspect and climbing attraction from Kaleh Dasht. From the Shah Rud, however, it is uninteresting. The plain of Kaleh Dasht is dotted with picturesque villages, whose cottages resemble Swiss chalets rather than the usual mud plaster dwellings of the Persian hill village. Fruit and walnut trees abound. This district would be excellent for establishing a textile industry which, together with the exploitation of the minerals, would be the most profitable development of enterprise in the Caspian provinces. At the present time the country produces only raw materials; and all finished products are even at normal times inordinately expensive, because there is no direct trade. All trade passes indirectly through commission agencies in Russia and the

Caucasus. Raw cotton is cheap, but a reel of cotton costs three times its European price. Cotton spinning in this country would succeed because of the raw material being at the factory door, the labour being cheap, and the markets extending to the whole Middle East and Southern Russia and Turkestan. The advantages of selecting Kaleh Dasht as the site for the factory would be the salubrity of the climate, the better work obtained from the hill people than from the plains people, and the facilities for water power.

The natives of Kaleh Dasht are a tribe that originally was brought over from Kermanshah; but it is so long ago now that they have lost their tribal characteristics, and have settled on the land, mixing with the indigenous population. Besides their barley cultivation and their sheep and cattle, they breed ponies, and the women weave carpets, but the quality is more on the level of the Caucasian than of the Persian carpet. This is the only district in which there is any carpet weaving in the Caspian Provinces, although, of course, the Turkoman country near Astarabad, famous for the beautiful Turkoman carpets, is not far distant.

It is only a day's march from Kaleh Dasht to the coast. One follows the Chalus road; and a few miles below the Chalus bridge one plunges into the coastal forest once more. At the mouth of the Chalus, when the mountains have come within 2 miles of the sea, there is a bazaar where the caravan road ends, and where the charvadars meet and exchange goods with the traders, who bring merchandise by sea from Baku. Here are also orange gardens belonging to Sipah Salar. The place was the site of a forty days' battle between the Kurjuri raiders and the people of Tunakabun—not so dreadful as it may sound, for the warriors remained in trenches and only five casualties occurred. No great fighters are these Persians, although they parade on ponies with a proud display of cartridge belts and obsolete rifles. The Gendarmerie are mostly recruited from the stout tribes of Azerbaijan. The Turkoman and Kurds are the best of the lot.

The Chalus road ceases at the bazaar; but many of the mule caravans continue their journey to Tunakabun, where they fetch rice to bring back to Tehran. The forest is impenetrable. The beach is their only road. But here the ride along the beach is bad going over soft sand and shingle—a contrast to the beach of the Mazandaran plain, which is good and hard enough to make an aviation ground. Fishery stations are found along the coast; but, as in Mazandaran, they are now ruined through six years of war, stagnation, and desertion. One finds also dumps of timber, oak planks, and boxwood logs, cut from the mountain forests and stacked, but still remaining on the beach waiting to be carried away.

It is tiring riding along the soft sandy path between the forest wall and the sea; and now in April the temperature is rising and the heavy air induces lassitude in horse and man alike. Since descending from the mountains one notices each day a diminution of the powers of the body accompanied

HOUSES OF MAZANDARAN

THE PLAIN OF TUNAKABUN

KALEH DASHT

TAKHT-I-SULAIMAN FROM KALEH DASHT

also by a torpidity of mind, and can understand how the climate depresses the inhabitants, who have to support it year in and year out; and one condemns them less for shirking work, sleeping the day in their houses, and hiring the labour of the hillmen to do the heavy work of the fields. Eighty per cent. of the adult population are habitual opium smokers.

At the Tunakabun plain, generally called "Tunakabun" simply, the mountains recede from the sea, the forest is entirely cleared, and the delta plain is covered with innumerable villages among ricefields. We turned off from the beach at right angles by the first metalled carriage road yet met, and rode along its embankment through the inundations into Khurramabad. The ride had been 30 miles that day, and Khurramabad was not reached until nightfall. That evening there was one of those typical vivid sunsets that one sees after rain in these parts. The air is still. The violent haze of the twilight tones the shadowed forests of the lower slopes to a leaden blue, while the snow-capped summits glow with the last red fire of the sun. All around are the flooded ricefields with their perfectly tranquil silvery surfaces reflecting the rose of the sky and gathering the mauve shadows of the trees and island villages. Over these swamps the air is hot, damp, and still.

In Khurramabad we stayed with the nephew of Sipah Salar, who was living in his house as manager of the estate during his uncle's absence; and a few days of his hospitality came as a pleasant rest after the riding of the last week from the mountains of Kujur and Kaleh Dasht. European society afforded a welcome change for our host too, entirely dissatisfied but resigned to his life of ennui at Khurramabad. But in this perhaps he was no different from most Persian gentlemen, pleasure loving, courteous, hospitable, witty and intelligent, overeating and entirely indolent. There is one serious topic, however, which always interests them: the future prospects of their country. A characteristic, emphasized since the war, is the resigned attitude Persians adopt towards corruption and disorganization. They mistrust one another in matters of integrity and public honour. Intrigue seems also to rule domestic as much as public life. But with all their inability to help themselves, they are animated by a sincere desire to see their country put in order, for they are ever a proud people, proud of their empire for its past greatness, proud of the fairness of their skin as a mark of racial superiority over their Eastern neighbours, and proud of their culture and polished manners. With all the Persians we met, we found that the future of Persia was always a vital and absorbing topic of conversation for them, and one on which they never tired of asking questions. Now that the war is over they look to the Western nations to help them to organize their country for they frankly recognize they cannot do it by themselves. And of all people the British are trusted the most, although individually the French may be preferred from a social point of view. But they want help only, not ruling.

Another strip of forested land, narrowing to 2 or 3 miles, separates the Tunakabun from the plain of Gilan. But one can cover half the distance by an inland route and escape the monotonous sand of the beach. The scenery is ever the same, forest, boxwood thicket, forest-smothered villages, rice swamps, river after river to ford, quagmires of mud and bog after rain. On crossing the border into Gilan the track takes to the beach, and so, in order to escape the monotony and also being pressed for time, we combined the last two stages into one and rode 42 miles into Langarud in a day, the baggage following on the morrow. At Langarud one reaches more or less well-known and mapped country once more, the province of Gilan being the best known of the Caspian provinces, as the Russian road from Enzali to Tehran passes through it. The province was considerably Russianized, European buildings being found in the towns. Also a good map has been compiled by Rabino.

After visiting the towns of Langarud and Lahijan we went into Rasht, and thence back to the Safid Rud to float down the river in a native boat to the mouth, where the important Russian fishery station is situated. The river has a changing course, and there is not sufficient gradient to enable water to be drawn off for irrigation, so there is little cultivation and few villages in this stretch of country, only forest. The fishery station was one of the biggest belonging to the Russian Company, built at great cost and equipped with tramways, ice plant, and electric light; but the changing of the river-bed in 1914, together with the advent of the war, put an end to work. Tomaniantz took over the place, and ran it on a small scale after the war. The caviare season is from the middle of March to the middle of June, when the sturgeon come up the river to spawn in enormous numbers. Each of these immense fish yields up to 10 lbs. of roe. The caviare is prepared in the following way: the roe, after washing, is mixed in a barrel of hot brine for ten minutes, then drained and packed in a sack. The roe, thus swollen and softened by the hot water and salted for preservation, is then squeezed in a hand press into a congealed sticky mass. In this condition it is left, still in the sack, for a few hours, after which it becomes solidified, and changes in colour from green to black. It is then finished and ready, and, emptied from the sack, it is packed in barrels ready for transport to Russia. The fish, after cleaning, are salted and despatched to Krasnovodsk.

Here at the mouth of the Safid Rud, close to Enzali, our reconnaissance duties were completed, so we set out to return to Kazvin, not by the military road by Rasht and the Safid Rud valley, but by a more direct route through Langarud, straight over the mountains, making a ride of 100 miles. The mountains in this western end of the Elburz are comparatively low and rounded. One can cross the ridges, first into the Shah Rud valley, and then over to the Kazvin plateau, almost anywhere, as there are tracks in all directions. The passes are about 7000 feet high. On leaving Langarud one traverses forested valleys until reaching the open

Chak Rud valley, the barley-growing district of Gilan. It is all switch-back work, ascending ridges and crossing valleys at right angles. The deepest gulf is that of the Shah Rud, the river being little above sea-level. Riding from day to day Kazvin was reached at the end of May; and here we heard for the first time the astonishing news of the Bolshevik landing on the coast near Enzali, where we ourselves had been only a few days previously.

One must hope that peace and order will come again to the Caspian country, for it is well worth development. Russian aggression must be checked, communications and roads must be made, the land and sea policed, and the natural riches of the land developed. Then the Caspian provinces will prove their value to Persia by contributing foreign export trade and internal food supply—economic contributions which are both vital for the rebuilding of the country.

Before the paper the PRESIDENT said: The lecturer this evening is not a stranger to us, for about two years ago he gave us a lecture on the approaches to Mount Everest, and he then revived the idea which had been dormant during the time of the war, of an expedition to ascend this highest mountain in the world. He was giving us an account of his experiences on a short reconnaissance from Sikkim in the direction of Mount Everest, and after his lecture there was a most interesting discussion in which our late President, and ex-President also of the Alpine Club, Mr. Freshfield, took part, and Dr. Kellas who has made many high Himalayan ascents also spoke, as well as Captain Farrar, the then President of the Alpine Club, who promised on behalf of the Alpine Club unstinted support towards this proposal. I also spoke on that occasion, and I remember I said that the chief obstacle in the way of any expedition to Mount Everest lay first of all in our own Government.

[*The President then related the receipt of permission from the Government of India and from the Dalai Lama of Tibet for the despatch of the Mount Everest Expedition, and described the steps which had at once been taken to organize the expedition, which have been published in the* '*Journal*'; *he then proceeded*:—]

Now we must get away from the neighbourhood of Everest and transfer our attention to the shores of the Caspian Sea. I will ask Captain Noel to read his paper on the Persian provinces of the Caspian Sea.

Captain Noel then read the paper printed above, and a discussion followed.

Brig.-General Sir PERCY SYKES: We have listened to an extremely interesting lecture, and we have seen excellent pictures. I feel quite sure that Captain Noel has also contributed an equally valuable addition to our geographical knowledge of that part of Persia. Before this, on our latest map, there was sketchy work more or less put down from hearsay. Now in the future we shall have some main roads and a good deal of cross-country work also set down. On my first journey in Persia twenty-eight years ago I started from Astrabad bay, a little to the east of where Captain Noel was, and I can sympathize with all he said about the mud and difficulties of travelling. I was there in mid-winter, and I recollect my greatest difficulty when riding was keeping my feet out of the mud. The Caspian Provinces give a remarkable instance of the influence of rainfall on history. The rainfall there is very heavy,

it has cut these extremely deep gorges, and below is all mud and forest, with the result that these provinces have been extremely difficult to subdue. In the seventh century, when the Arabs conquered Persia, they took over the rest of Persia without any trouble, but could not take the Caspian Provinces, and for 120 years longer they remained independent, and would have continued so much longer but the members of the ruling family quarrelled among themselves. One famous English traveller, Jonas Hanway, visited this part of the world about 180 years ago with the idea of trading across Russia with Persia. He landed at Astrabad bay, went to Astrabad, and came into one of those nasty little revolutions. They took all his goods and wanted to make him a slave; but he was let off, and then went right along the shore of the Caspian to Resht, and had a most terribly bad time with no clothes or supplies, all having been taken by the rebels. He went to Nader Shah, who was in camp near Hamadan, and obtained an order for the restitution of his property, came back with it, and saw the terrible punishment meted out to the rebels. Pillars of plaster had been built and had been decorated with the skulls of the rebels, and in his book published in 1753, 'An Historical Account of British Trade over the Caspian,' there is an illustration. One result of that journey is remarkable. Hanway had been in the country where, as Captain Noel has said, it is always raining, and when he came back to England he had a very bright idea, and introduced the umbrella to England. In England, perhaps, Hanway is celebrated for having introduced the umbrella. In Persia we regard him as one of our great Persian travellers.

The PRESIDENT: We are very glad indeed to congratulate Sir Charles Yate on the honour of Baronetcy, and we shall be very glad if he will speak.

Colonel Sir CHARLES YATE, M.P.: Like Sir Percy Sykes, I entered the Caspian Provinces from the east, from Astrabad, and I never had the opportunity of going through Mazandaran and Gilan, of which our lecturer has given us such a very illuminating account this evening. I agree with Captain Noel in emphasizing the importance to Persia of these two provinces. He has told us of the mineral and other wealth to be got from them, and, as he told us, one of the saddest facts for Persia, viz. that the whole of that country has been entirely monopolized by Russia. Naturally in such a mountainous district there are no easy roads communicating with Tehran and the rest of Persia, but these, I hope, will come in time. I quite sympathize with all you have heard described of the mud there, for I travelled down to the coast through the mud to embark on a Russian steamer there, and I remember it well. Mules when they travel along there all walk in the same step that the others have taken before them and put their feet from one hole into another, and the road is thus one succession of mud-holes. Now the contrasts along the southern shores of the Caspian are the most extraordinary I think I ever saw. I was there in the winter—in December—and the mountains come down near Astrabad very close to the sea. A few hundred feet up the whole mountains were a mass of snow, and yet along the shores of the Caspian just below the oaks and other trees were all in full leaf; bracken, brambles, and rose-bushes were all in full flower; and hawthorns both in flower and berry. The heat was great riding along in the sun at midday, although the snow looked as if you could touch it almost above you. The country is a wonderful one in the way of shooting. At Astrabad woodcock are the great sport. I could go out of my tent and shoot half a dozen woodcock almost at any time. You also saw them coming flighting in from the hills at dusk to get into the gardens round the town of Astrabad, and it took a good shot to kill them then. I can absolutely support all that

was said about the number of wild pigs in the country. I could not understand at first how it was that the trees along the roadside were full of pigs' heads, and eventually I found that this was the way which the guardians of the cultivated ground used to show how successfully they did their work. They were like our mole-catchers here. In that country you found pigs' heads stuck up in the trees just as mole-catchers here stick up the moles they have caught on the nearest hedge. I did not see any of the great Caspian stags the lecturer has told us about, but I got some good specimens of their horns. The Caspian Sea, as you know, has been entirely dominated up to now by the Russians. Under the treaty of Turkomanshai the Persians were forbidden to have any vessels on the sea. The only vessel which the Russians allowed the Persian flag to be flown on was the Shah's yacht. That was the only Persian vessel they allowed on the Caspian. The shores were dominated by the two or three little Russian men-of-war that went all round and kept order, and they monopolized all the trade. There were, too, Russian fishery stations all along the shores of the Caspian, and in fact everything was Russian. We had a chance a short time ago of altering this when, you all will remember, a British force of naval men went up all the way from Basra through Baghdad to Resht and Enzali and eventually formed an excellent fleet on the Caspian under Commander Norrie. That little force of British sailors did wonders on the Caspian. I remember bringing the scheme to the notice of the Government. I said, "Just look what we have done in East Africa. Look at Tanganyika. There we sent a small naval force, with boats in sections, and were able with those boats to sink all the German ships on that lake." I said the same thing could be done in the Caspian. It was done. We got a big gun on the Caspian; we eventually acquired the ships on the Caspian; and we could have dominated the Caspian to the present day had we held on. Unfortunately those ships were subsequently handed over to General Denikin, and the Bolshevists now have possession of all those ships. They are thus able to dominate Enzali and Resht, and are now threatening our own forces at Kazvin, and when that small British force is withdrawn will certainly threaten and possibly take Tehran.

The PRESIDENT: I was very interested to hear from the lecturer that the first to visit the part which he described was J. B. Fraser—that is, James Baillie Fraser, who was a member of the Council of our Society in the thirties, one of our very first Councils. He was a remarkable member, an East India merchant who gave up his interest in business and made some very fine journeys in the Himalayas, which were then almost unknown. He was a considerable artist, and painted some excellent pictures of the Himalayas, which at that time were thought not to exceed 17,000 or 18,000 feet in height. They were almost unknown in those days, and these pictures he had reproduced in England at great expense. From the Himalayas he went to Persia. He wrote two interesting romances about Persia, but I did not know until this evening that he had travelled in these provinces of Persia of which we have had such a delightful description to-night. We are very glad to hear of him again, to hear of one of the first members of Council of our own Society. I think many of us have been surprised to hear from the lecturer what a very rich country there is along the borders of the Caspian Sea. His reconnaissance is very valuable, and we are very glad he put his military notebook into his pocket and took his camera and gave us those most beautiful photographs which we have seen this evening. When one hears from him of the Persians there being so hospitable and so anxious to have help from us, and when one

sees officers like Captain Noel, of whom there are hundreds in this country only too anxious to give the very kind of help these Persians need, we do hope it will be possible that we should come together, that we should give the Persians the help that they need. As Sir Charles Yate has said, it depends entirely upon themselves. If they have the wisdom to ask for that help, there it is forthcoming, and we certainly hope that the decision they make will be that they shall ask us for that help, and we shall be able to revive that wonderful country, and make it blossom forth as we have seen from the lecturer is possible. I am sure on your behalf you would like me to thank the lecturer for his most interesting account and his admirable photographs.

THE SCENERY OF GREECE

A. W. Gomme

Read at the Meeting of the Society, 4 *April* 1921.

YOU have probably before now listened to amateurs who, coming forward to address you, begin by apologizing for being amateurs. But there is a special reason for an apology in my case, for not only am I not a geographer, I am not even a traveller. I have been to no distant countries nor unknown shores. I have wandered a good deal about Greece (though I should hesitate to confess how much of that country I have still to visit), nothing else; and if I nevertheless venture to speak before you, it is—well, chiefly because the honour of an invitation from this Society could, obviously, not be refused. But in addition I have been encouraged by reading the address which your President gave at the anniversary meeting last year. In that address he suggested that "the characteristic of the face and features of the Earth most worth learning about, knowing, and understanding is their beauty; and that knowledge of their beauty may be legitimately included within the scope of geographical knowledge." It is important to compare the beauty of one country with that of another; and if I cannot discover for you either "a new region which possesses special beauty or a new beauty in a region already well known," and if I am certainly not the poet or painter which Sir Francis Younghusband rightly required, yet my words may be taken as an obligato, as it were, to the exhibition of lantern slides which you will see, many of them of quite exceptional merit, and to that still difficult task I will address myself.

I was encouraged, as I say, as I read Sir Francis' paper—until I came to the last page, where he says: "this (the description of the beauty of the Himalaya) that we want of the greatest natural feature of the Earth is only typical of what this Society should require in regard to all Earth's other features in order to make our geography complete. As men have pictured the loveliness of England, the fairness of France, the brilliance of Greece, so we want them to picture the spaciousness of Arabia, the

luxuriance of Brazil, and the sublimity of the Himalaya." Greece, then, has already been done. But, fortunately for me, I quarrel with the word "brilliance"; and I shall try to-night to explain why. The task of analyzing and describing the beauty of a country as opposed to recounting its features is, I suppose, analogous to that of the critic of literature or art who seeks to explain the æsthetic effect intended and produced by a poem or a picture, as opposed to one who gives an historical account of artists and poets and their methods. It may be equally fruitful of good in the right hands, and is certainly equally dangerous and open to facile rhapsodizing and shallow generalization.

When I speak of Greece I mean, by the way, that part of the modern kingdom which lies south of Mount Olympus, including of course the Ægean, but excluding Macedonia and Thrace. For this region, corresponding nearly both to modern Greece before the Balkan wars of 1912–13 and to the lands of the classical Greeks, has a common quality which marks it off and separates it from all others. But before touching on this common quality, I wish first to speak of and emphasize what I think is too often ignored in the scenery of Greece, namely its variety. Leaving on one side the smaller variety that is naturally found as you pass from one village to another, or ascend a hill slope and go down its other side, you can divide the country into four or five districts each with marked characteristics of its own. There are, for instance, the onian Islands, there is north-western Greece, the great inland plains, western Peloponnese, and finally eastern Peloponnese, Attica, and the islands of the Ægean. I will say a little about each district in turn, asking you to bear in mind that in drawing, as I hope, the characteristic outline of each I must necessarily omit the multitude of details, the inner modelling, as it were, that go to make up the rich content of the whole.

Of the Ionian Islands I shall say least. I have no good pictures; if I had, they would not give you a very satisfactory idea of the country; and these islands—excluding Ithaca, the very Greek home of Odysseus—but Corfu, Leucas, Cephalonia, and Zante—these four share less than any other part of the country in the common quality of scenery that distinguishes Greece from the rest of Europe. As in politics and in culture, in ancient times and during the Turkish ascendency, so in the nature of their scenery these islands stand apart. In the later period, when they escaped the Turk and were ruled by Venice, they had more associations with the West than with Greece, and the Italian-looking houses of their capital towns still recall the old Venetian ascendency. But in natural scenery they are no halfway house between Greece and Italy, but have a character of their own, an abundance, a Southern luxuriance which is not Italian, and is yet quite foreign to Greece, a quality which has made them so much liked by those unhappy men who get no pleasure from the austerity of Attica and the Argolid. Beautiful these islands are, but almost of a different world from the islands of the Ægean. Here it is not

the confines of the picture which delight, a wide stretch of country and the distant outline of mountains, but the manifold contents of the foreground—grass, flowers, trees, streams, rich cactus hedges ; except in one view, that to the east over the sea to the opposite mountains of the mainland, high, exceptionally bare, steep-to down to the water's edge, turning from grey to orange and purple as the sun sets. There in Epirus is the true Greek land, not here in the rich isolation of Corfu.

The inland plains are but three in number, but being of great extent are an important feature in the scenery. They are Thessaly, Bœotia, and the plain of Tripolis in Arcadia. They are alike both in outward appearance and in geological formation, being the floors, I believe, of former lakes, enclosed by a mountain barrier, with no natural outlet for their waters, which in the case of the first two are of an abundance rare in Greece. To-day most but not all of the waters of Thessaly are carried off by the Peneus river through the famous Vale of Tempe ; but in the eastern plain the level of the ground slopes gradually downward away from the Peneus bed, and a lake regularly forms in the south-east corner. In Bœotia the Copais lake has been artificially drained in recent years and is now cultivated ; while in the plain of Tripolis the waters find a precarious and changeable outlet in natural tunnels in the limestone formation of the surrounding mountains.

As you would expect, therefore, these plains are heavy of soil, often waterlogged, as flat as the fens, and, in a country where ditches, hedges, and trees in hedges are unknown, of a great monotony, which is broken only by the trees that are to be found in the comparatively rare villages and along the banks of rivers. These plains are the chief wheat-growing districts of Greece, and consequently in winter and spring you have an expanse of green while the corn is yet young, in June an expanse of yellow ripening corn, and after that nothing but stubble or ploughland till November sees the green reappear. The monotony is not, of course, nearly so vast as that of the plains of Roumania, but it is of the same kind except for this one all-important circumstance—the line of mountains and hills which surround the plains, which are large only for Greece, so that in the centre of the flattest land you are never far from the mountains that are the frame of any picture in Greece. A plain from which you can see Mount Olympus can never be entirely dull. But, as if to declare that large and rich plains are hardly proper to a land of mountains and stony valleys, you find, especially in Thessaly, what is most foreign to Greece—a thick atmosphere, so that often in summer mountains not 15 miles away will show no inner details such as are the delight of travellers in Greece, and but a hazy outline. The geographer Philippson tells us that when he was crossing Mount Othrys, the range that bounds Thessaly on the south, his guide, who was a Peloponnesian and had never before been in northern Greece, as they suddenly found themselves, more than 3000 feet up, overlooking the whole plain of Larissa, exclaimed, like the followers of

Xenophon at the sight of the Black Sea, "Thalassa, Thalassa!" If he saw it on a day of heavy atmosphere in the plain, this is just the appearance that would present itself from above. And so rare are plains in Greece, that this inhabitant of the Peloponnese could not believe in the existence of a flat piece of land some 40 miles by 20 in extent.

A third district, with a character the very opposite of that of the plains, is north-west Greece, comprising practically the province of Ætolia and the whole range of Pindus. This is a land generally of high and bold limestone mountains, well watered with many streams and some considerable rivers, which run through remarkable gorges, well wooded, and with fewer patches of cultivable ground than any other part of Greece. It is not arid, bare, and stony like the eastern districts, but, except about the lake of Agrinion, it has hardly any level land. Its characteristic tree is not the pine, but the fir; and more to the north, the oak and beech. The cherry, the plum, and the apple are grown, not olive-trees. No carriage road runs across it from west to east, nor has ever done. It is an untamed and most beautiful land, whose inhabitants, mostly shepherds and woodsmen, lead an independent life apart from the rest of the country, just as did the Ætolians of old, down in the villages in the narrow valleys in winter, up on the tops of the mountains with their flocks in summer. There is much variety of scenery, and the paths take you now steeply up a wooded mountain-side, now in a small cultivated valley, now along a narrow ledge cut out of the shaly hill-side or through a narrow gorge with high overhanging cliffs, with many streams and springs and an ever-changing view, and very rare villages. One path goes for a whole day's journey above the 5000-feet level; once I was surprised, after much climbing up and down, by a level stretch for about 3 miles (we were 3000 feet up), and with sandy soil, covered with grass, bracken, an occasional wheatfield, and copses of fir trees; except for the distant peaks and the blue sky it might have been a northern land. At the end of July, when the harvest elsewhere has all been gathered in, even in Thessaly where the winters are cold, the corn is still green; and when you stop for a rest at noon, though there is no cloud in the sky, you are glad to sit in the sun. The proper qualities of Ætolia and the Pindus are boldness and splendour; the boldness of cliffs and high mountain land and deep valleys, and great views from high and commanding points; while everything is fresh in a well-watered land.

Western Peloponnese, the fourth of the five districts into which I have very roughly divided Greece, is also a well-watered country, but of a very different aspect. Here the dominating lines are horizontal, not vertical. It is hilly country, very hilly; but you need climb but a short way, some 200 or 300 feet only, and you have a broad sweep of country before you. The lower valley of the Alpheus, after it has left the gorges of its upper course, is typical, and Olympia is its centre—the most beautiful spot in all Greece, Dionysius of Halicarnassus called it, where Greeks from all over

the Mediterranean collected every four years for the festival, as a mark of union and brotherhood, the one place and time at which they did not quarrel with each other. From hills behind the sanctuary you can see up the wide river valley as far as the distant mountains of Arcadia. The nearer hills are covered with a peculiar, very light-coloured soil—remember that it is remarkable in Greece to find hills covered by soil, except the very thin soil that will support the pine or prickly oak—and on them grow a dense abundance of shrubs, bay and myrtle, and pine trees; below are the vineyards, and everywhere the ground is carpeted, in spring, with flowers, hyacinth, orchid, and anemone; a paradise among lands. What distinguishes western Peloponnese from eastern is, roughly, its greater rainfall and abundance of water, a depth of soil unknown elsewhere in Greece, and the great distance of the high limestone mountains from the seashore, so that there is a long stretch of what the Germans call *Schollenland* between the mountains and the sea, a rolling country of hills, often steep hills, but, as I said, all covered with soil, hence with gentle outlines, and the whole having a horizontal, wide-spreading appearance. It is the country of the currant. As you know, this particular form of grape, just as it is only eaten by English-speaking peoples, so it only grows in Greece (or practically so; it is now cultivated to some extent in Australia). But it also only grows in certain well-defined parts of Greece, namely along the southern shore of the Corinthian Gulf, all down western Peloponnese as far as Messenia, and in the island of Zante; nowhere else, not in inland or eastern valleys where the common vine and the olive flourish. This southern shore of the Gulf of Corinth belongs then culturally, as also I believe geologically, to western Peloponnese; but it is so narrow a strip of cultivable land, and the mountains slope down so steeply and so close to the shore-line, that in its scenery it is quite different, and belongs to a particular district with a character all its own, the Gulf of Corinth and its shores. On the north, except in a few places, such as the small and delightful bay of Vitrinitsa and Itea, backed by the olive-covered plain of Amphissa which retreats up into the mountains and the great pass by which goes the road to Bralo and the north—except in such places, the mountains come down bare and forbidding to the sea. On the southern shore is this rich strip of flat land, very green, with white villages and towns; behind are steep but cultivated hills, marked everywhere with slender dark lines of cypress trees; the whole backed by the mountains of the Peloponnese, broken here and there by romantic gorges down which rivers pour their destructive waters and spread themselves into a broad waste of stones as they cross the narrow belt of flat land between the mountains and the sea.

If you go from Olympia across Arcadia to the Argolid, you realize quickly the difference between western and eastern Greece. As you ascend the valley of the Alpheus you are for some time in the rolling glebe-land of Elis; then when you get among the limestone mountains you climb up

and down—mostly up—dry and rocky paths, very fatiguing, the slopes on either side covered with prickly oak only, and many herds of goats feeding on them. This suggests the drier lands of eastern Greece. But Arcadia has to be crossed first—quite different country again, with high mountain ranges and great fir forests, and upland plains that more than any other part of Greece recall the upland plains of Switzerland. Greece is not very like Switzerland; its mountains, its valleys, its atmosphere have a different quality. But this part is least unlike, especially if from Demetsana, that fantastically situated town in western Arcadia, you take the high-road that goes across to Tripolis in the east. Just beyond Demetsana you come to a plain where the straight road, the river almost as straight running beside it, the fields, the fruit trees, and the grazing land on the lower slopes of the surrounding fir-covered mountains—the plain is so high that the vegetation has a northern character—call to mind the upper valley of the Rhone. Arcadia differs from the Pindus district in being altogether an upland country—these plains are 3000 feet and more above the sea—and you have not those remarkable deep gorges that so break up the mountainous country of Ætolia; and being already so high up, you do not get the same impression of steep grey mountains above you. The road I have mentioned, after going through all northern Arcadia, ascends through fir woods the slopes of Mount Messapius to the top of a pass, some 4000 feet up, then descends in many winding curves, traverses a pleasant rolling country, then climbs again a barer, severer range, and descends rapidly to the plain of Tripolis, and we are in eastern Greece: still 2000 feet up, and it is a long descent before the Argive plain is reached, but the boundary is crossed.

The Greeks have a story that when God was making this world He passed the earth through a sieve, and put down soil here for France, there for England, and so on everywhere; and at the end He had a great pile of stones left in His sieve, which He just threw over His shoulder and they became Greece. This would be especially eastern Greece, by which I mean roughly the whole eastern coast-line, the Argive peninsula, the Isthmus, Attica, the mountainous part of Bœotia and Phocis, including Delphi, Eubœa, and all the islands of the Ægean. I have left this to the last, to lay most stress on it. It is, in one sense, the most characteristic part of Greece. I do not mean that the rest is not characteristic; but it is so in a different sense of that rather vague word. I mean that there is a quality common to all Greece which makes it different from any other country, and of that quality eastern Greece has a larger share than any other part; whereas of those qualities which Greece has in common with other countries, other Mediterranean countries anyhow, the rest of Greece has a larger share than have Attica and Argolis. This special quality is easily recognized when one is in Greece, but is not easy to describe with accuracy.

It is due largely to the dryness of the atmosphere. As to the rainfall,

nowhere in Greece is it considerable compared with that of the north-west of Europe, but it rains much more in western than in eastern Greece, more than twice as much in fact. In Athens, the driest, as it is also the sunniest, place in Greece, the rainfall is only a little more than a third of what it is in Zante; only a fourth of that of Corfu. The dryness and consequent clarity of the atmosphere is therefore astonishing, because so much greater than that of ordinarily clear atmospheres, as in South France, Italy, or Macedonia. Then the mountains are in general not so high as in Arcadia and Ætolia; they range from 3000 to 5000 feet, as against 6000 to 8000. The greater number are bare of trees, growing only scrub and bush. Where there are trees they are mostly pines; and these with their light green colouring, their twisted trunks, and umbrella-like shapes contrast markedly with dark green and upright stems of fir trees. The plains are small in extent and slope down gradually and spread out to the seashore. The soil is light, too light for wheat, though barley is grown; light in colour too; for the most part you find vineyards and olive groves; occasionally vegetable and tobacco fields. Other trees are the plane and the white poplar; oleanders grow profusely on river-banks or in the dry beds of streams. Hardly any rivers run continuously to the sea.

This greatly affects the colour of the country as seen from a height overlooking a plain. In spring you can see growing barley, the grey-green of the olive, the most delicate silver-green of the poplar, and the brown of plough-land. But the barley is harvested by the end of May, and after that the light brown of the soil is only varied by the never-failing olive and the dark green patches of vines or tobacco. Behind are hills purple with thyme, or the blue Ægean Sea.

You will have noticed that, except in a digression on the Gulf of Corinth, I have so far hardly mentioned the sea; and the omission may seem strange in speaking of country like Greece. Yet it is true that in western Greece, always with the exception of Ithaca and the coast-lands of Epirus, the sea is not the important feature of the landscape that it is in the east; just as the Greeks of the west, especially in western Peloponnese, have not taken to the sea as have the men of the east and the islands. For in eastern Greece it is not as a blue background with level horizon that the sea plays its most important part in determining the character of the scenery. It is where it meets the land—it is the actual line of the shore that is important, that is so fascinating to look at, so magical in its beauty. As I said, the plains here spread down to the sea; the plains of any extent, such as those of Argolis, Attica, and Chalcis, are few, but at the head of almost every bay of this so-much-indented coast there is a tiny plain. So that if you sail along the shore, close in, you have an ever-repeating and ever-varying alternation of irregular and rocky coast-line and the smooth curve of a strip of sandy shore. Fortunately photography can well represent this, especially photography in the hands of artists like Boissonnas

and Baud-Bovy, and their pictures will explain my point better than I can. These are mostly of the islands of the Ægean, each one of which has its own special character and individual beauty. But I would direct especial attention to one, namely Delos. This tiny island has not that advantage which is common to almost all the islands of the Ægean, a bold or harmonious outline when seen from the sea. It is not lofty, its highest point being but 500 feet above sea-level. It has no steep cliffs; and it has no specially attractive colour, for no tree grows there, nor anything green. It is a bare, rocky islet, quite dominated by its neighbours Rheneia and Myconos. But climb the hot and wearying path that leads to the top of that hill, and look down at the coast-line below, and you will be rewarded for your pains: the clearest possible line of sea and coast.

Such a view is to be had at almost any point near the sea in eastern Greece south of Volo (the coast of Thessaly is different), whether sailing by the shore or walking on land. Some headlands are high and steep—all are rocky—some bare, some covered with pine-trees to the water's edge; some, most delightful of all, are crowned with the ruins of ancient temples; some bays are wider and with flatter curve than others; while occasionally you pass a plain of exceptional richness, like that of Trœzen opposite Poros, which is covered with lemon and orange groves; but always this well-defined and sunny coast-line.

That, however, is for the nearer view. The distant landscape is bounded by the gracious and harmonious outline of the hills. Here you see most clearly the different quality of eastern Greece. In Ætolia or Arcadia the mountains are higher, nearer, more immediately above you, and dark and rich in colour, where fir trees clothe their slopes. If the trees cover all the mountain up to the summit, the outline is confused and the inner markings, the modelling of ridge and valley, are lost. I don't mean, of course, that the Arcadian mountains have the soft and rounded contours of northern hills; but they are not so clearly defined and, above all, not so light as those of Attica or Argolis or the islands. The outline and the light are the essentials, the points to be emphasized. The colours are the most delicate possible; green, the light grey of limestone, the blue of distant hills—not the blue of distant trees and hedges that you get in England—the purple shadows in the early morning and the orange and rose that suffuse all the hills in the evening; all are light and cool colours; not pale or washed out—the very opposite—nor confused one with another, but each clear in itself, and bathed in light; luminous colours. The best word I can think of to describe the general effect in Greece is translucence. It would be an exaggeration, but only an exaggeration, not a distortion of the truth, to say that the effect is like that of light shining through thin marble or alabaster. In other countries, of more generous soil, the colour of the sky may be luminous, but the colours of the earth are of a different quality, richer and more opaque;

in Greece the quality of the colours of the earth is the same as that of the sky, equally luminous and cool. You will see now why I think that "brilliance" is not the right word to describe Greece; at least it suggests to me rather a variety of rich and hot colours, or a sparkling hardness, not the delicacy of Greek colour and outline. It may surprise you as much as it did and does me; but the country which seems to me likest Greece in the delicate colouring and luminous atmosphere of a distant view, is the country of the Campsie and Kilpatrick hills near Glasgow, on a rare fine day in winter. It is remarkable how clear the air can become on a sudden in that rain-soaked land.

You know the story—very typical of Greek artists—of the two painters Apelles and Protogenes. Apelles went to call on Protogenes, but found him out; and when the servant asked who should she say had called, he took a brush and drew a fine line on a canvas, saying that Protogenes would know who it was. The latter came in afterwards, recognized the master's hand, took another brush and in another colour drew a finer line over that of Apelles, and told his servant to show it him when he called again. Apelles did call again, and drew a third and yet finer line on the other two; and Protogenes then confessed himself beaten. Well, that gives one an idea of the lines of Greek scenery, whether the inner markings that divide light and shade or the outline of hills against the sky; they are quite definite, but as far from heaviness as from confusion. It seems to me that one is helped to a perception of this by a sentence in Mr. Bertrand Russell's 'Introduction to Mathematical Philosophy,' in a passage where he has been defining mathematical continuity. I hope I am not quoting words which I don't understand—a thing one is always afraid of in quoting from a mathematician; but at least it requires no apology to take a simile from mathematics when speaking of Greece. "The general idea," he says, "vaguely indicated by the word 'continuity' when employed by many philosophers (which is a kind of fog), is one which is certainly quite different from that which we have been defining. Take, for example, the series of real numbers. Each is what it is, quite definitely and uncompromisingly; it does not pass over by imperceptible degrees into another; it is a hard, separate unit, and its distance from every other unit is finite, though it can be made less than any given finite amount assigned in advance." So it is in a Greek landscape; there are no foggy outlines, and one colour does not pass over imperceptibly into another; the difference between two neighbouring colours may be almost infinitely small; but the lines remain quite definite. You can use of Greek scenery the phrase often used by the ancient critics of Greek art, "the accuracy of its beauty."

Argolis has this distinctively Greek characteristic of delicacy and definiteness of colour and outline more purely perhaps than any other part of Greece; just as the ancient Argive school of sculpture possessed that quality which is so distinctively European when compared with Asiatic

art, and yet is so particularly Greek that it has never reappeared in Europe in so pure a form. Attic art had a wider range and more variety than Argive; so is Attica more varied than the Argolid. There are walks there in shady glens, where the orchid and narcissus grow among the streams of the Cephissus river, of which Sophocles sang; Attica has almost all that Argolis has, and more besides. But Argolis is, as it were, the test. If you are content there, say on the citadel of Mycenæ looking over the plain towards Argos and Nauplia and westwards to the mountains that border Arcadia, then you have penetrated, at least I think so, into the austere spirit of Greek landscape.

I wish my words were anything like so clear and definite as the country I have been trying to describe. I have, of course, left out much —not detail only, but I have said nothing of the mountain country of Olympus and Ossa and Pelion, very different from the rest of Greece, nor of the rich plains of Messenia and Sparta, nor of Mitylene or Chios; nothing, above all, of Crete, which has a variety ranging from the bare mountains of the east to wooded slopes and copses where foxgloves reach above the bracken amid the roots of oaks and beeches. But time, and I am afraid your patience, forbid. But I hope what I have said means something, and describes in some measure that quality in Greece which makes you feel you are in a different land when you cross over into it, not only from Italy and the west, but even from its immediate neighbours on the north, Macedonia and Thrace, Serbia and Bulgaria, all of which despite their nearness to or contact with the Ægean belong in the character of their scenery to Central Europe and not to Greece.

Before the paper the PRESIDENT said: The lecture this evening on the Scenery of Greece by Mr. Gomme, who has been for many years out in Greece, is in the nature of a new departure. We in this Society are accustomed to take a perhaps rather limited view of Geography, but in this lecture we hope to hear of the beauty of Greece, and not merely of its physical measurements. We consider that a description of the beauty of the country is just as important as its accurate physical measurement. Geography is the description of the Earth, and the part of the Earth which Mr. Gomme will describe this evening is Greece, and he will describe, not the height of the mountains, the length of the rivers, and the contour of the coast-line, but the beauty of its scenery. Personally I look forward to the time when Mr. Reeves will have a colleague in our Society. Mr. Reeves, very efficiently and with very great success, teaches intending travellers the way to map a country and the way to take accurate measurements of the mountains, rivers, and so on, but I hope the time will come when he will have a colleague who will teach intending travellers the way to observe, and the way to describe the beauty of a country. This lecture is, as I say, the first step in that direction. We have a traveller who is more especially concerned with observing and with describing to us the natural beauty of a country he knows. Mr. Gomme was a student in the British School at Athens, and has for many years past spent a few months travelling in Greece. He is thus very intimately acquainted with it. I ask Mr. Gomme to give us his lecture.

Mr. Gomme then read the paper printed above, and a discussion followed.

The PRESIDENT: Will Prof. Myres, whose knowledge of Greece is so very great, and who gave us such an excellent paper on the Dodecanese last year, kindly open the discussion?

Prof. J. L. MYRES: It is a very great pleasure to have the opportunity of expressing my appreciation of the paper to which we have just listened. I know Mr. Gomme knows about Greece, for we only just escaped being colleagues years ago in the Classical Department in Liverpool University. I know he has been in Greece, because we had the happiness of working together there during the last few years. He has illustrated in very happy fashion the kind of synthesis and interpretation which you, sir, called for so suggestively in your Presidential Address last year. We call the rainbow, for example, a beautiful thing, and appreciate its beauty all the while that with the spectroscope and other means of accurate determination, we translate the physical fact which we feel to be beautiful, into accurate measurements and statistics. And in the same way we are beginning, I imagine, to learn the alphabet and some of the grammar of the language in which scenery in any country speaks to us. Like people who will go and see a Greek play and feel (though not understanding a word) that this is a big thing, and that the bigness of it centres in the language, so we too are impressed when we come face to face with great pieces of Nature's eloquence. They have style, they have meaning, like the spoken word; they leave us a little different from what we were. Using, too, another word "picturesque," which like "style" has gone downhill, when we distinguish between one style of scenery and another, and say that this or that is "picturesque," I suppose that what we mean is that others have been before us in appreciating scenery of that kind, and have made their schoolboy translations of the great original. It is thus that without any disrespect I would characterize those extremely interesting sketches which Mr. Gomme has presented to us, along with his photographs. I would pay them the compliment of regarding them as an exceedingly interesting attempt to translate into a rather simpler language some of the eloquence of the scenery of Greece. Some of them—and especially the sketch of that view from Delphi—have shown me things which I did not quite understand from study of the place and photographs. I must look at the photographs again and see if that translation is right.

Why is it that one feels (and all the more as one comes to know the country better) that Greece is, in some special sense, a beautiful country? I think it is partly this, that as some of the greatest literary style is the simplest language best used, so the message of Greece, the signals that it gets through to the ordinary human being who is trying to be a wild man once more, are signals of the simpler and more emphatic kind; partly, I suppose, because of that extraordinary clarity of the atmosphere. There is no doubt of the shape of a hill in Greece. It is not merely the almost total absence of obscuring vegetation. You do really see what is there, sometimes in a disconcerting way. You feel you can count the stones on the hillside—and with a glass you could count them! And yet even in this clear air there is frequent refraction and most elusive mirage. Walk daily over the slope of Lykabettos, as I have for many months together, and see the same Acropolis coming out over the spur; never to the end of my time was I able to discover exactly where the horizon really cuts the profile of the Acropolis. So infinitely various is this apparent precision of statement. And the simplicity of the message of Greece comes partly from the circumstance which most differentiates this Nearer East

from our West, also that, in spite of its very small rainfall, it has, in the long past, suffered far more ruthless denudation. That comes out in the first great descriptive analysis of Greek scenery (as distinguished from mere description) in Plato's dialogue *Critias*, where the question is raised, How is it that the Greece we know is so different from the pre-historic Greece which Socrates has been trying to reconstruct for his young hearers? And the answer is that "there have been great floods of rain since. What you see now is like a dead animal with the bones sticking through the skin." Then the intelligent young man asks, "Where is all that earth gone, and why have not we great mud flats inshore?" and the reply is, "You know how deep the sea is round here: it is not filled up *yet*." It is that kind of simplicity of statement as to what is, and has been, going on in Nature, that I think makes Greek scenery so ideal an introduction to that kind of natural "eloquence," to the message which one's own experience brings, as one watches any kind of scenery; and which makes one so especially grateful to Mr. Gomme for the way in which he has brought home to us some of its salient characteristics.

Sir MAURICE DE BUNSEN: I am not qualified really to speak about Greece, but I am glad to add my thanks to those which have already been expressed to Mr. Gomme for his lecture, which to me has been extremely interesting and instructive. I think he has kept very strictly indeed to his subject of the natural beauties of Greece. By taking the photograph so as to include an old standing column or a corner of the Acropolis he might have attached to the picture some quotation from the Classics which he knows so well, and have told us the history of the particular scene shown to our eyes; but even in what he showed us he kept to his subject—the beauty of the scenery, and the different characteristics of the scenery in different parts of the country. It has been very instructive, and I think it will no doubt lead many to read up our Greece. Having for many years entirely neglected the Classics, I have in recent years taken to reading them again, and the lecture I have heard this evening will make me pursue my reading into the realms of Greek classic literature, as I have already begun with Latin. It is now so easy for everybody who has the slightest knowledge of those languages to read them in the Loeb edition, which really is nothing more than the beautiful original on the one side and a very good crib on the other. I have derived great pleasure and instruction from the lecture, and wish again to thank Mr. Gomme for what he has said to us.

The PRESIDENT: It is perhaps time that I should sum up the discussion. Mr. Gomme quarrelled with the use of the word "brilliance" in describing Greece in my Presidential Address last year, and perhaps I should make a confession in that regard. I was not, at the time, thinking how I should sum up the beauty of Greece in one single word, but as a matter of fact I had that one single word "brilliance" in my mind, and I was looking about among the different countries in the world I had visited for one to which I could apply it, and I applied it to Greece, because on the last occasion upon which I went through Greece, leaving here in the month of December, travelling across the Continent at the dullest time of the year, coming down from Constantinople also thick in cloud, and emerging into the Ægean Sea, with the beautiful islands of Greece glittering in sunshine and set in seas of dazzling blue, brilliance was the exact impression which lay upon my mind. So I hope the lecturer will kindly excuse me for applying the word to Greece. But at the same time I agree that there is much to say for the word which he would wish to substitute for brilliance, namely, translucency. I had not

particularly noticed this translucency in Greece, but I have observed it in other countries, and it is specially noticeable in comparison with the atmosphere of this country. In countries where the air is extremely clear, as it is in Greece, and where the colours are very definite and the outline of the country very definite too, one does get that quality for which the exact word is translucency. Natural features appear to be not opaque but translucent. Another interesting point which Mr. Gomme brought out and which it is well to remark and remember, is about the purpleness of the shadows. If you take a flower and hold it up to the shadow, you see there is not much difference between the purple of the thyme and the purple of the shadow. When I saw those pictures on the screen of the monasteries back away in inaccessible points on the cliffs it reminded me of Tibet. The photographs might have been taken as well in Tibet as in Greece. In both countries these monasteries of solid masonry are built up against cliffs in very inaccessible points, and there the monks lead their secluded lives. I suppose they were originally built there as being safe from attack in troublous times or as being well secluded from mankind. But the monasteries in Greece are not of the size of the monasteries in Tibet—some of the monasteries near Lhasa being almost towns, and the monks numbering 5000, 6000, and even 8000. Mention has been made of Socrates and his conversation with his pupils as to why the mountain-sides have changed. There is one cause of the change which possibly was not recognized by Socrates and was not mentioned by the speaker, and that is the goat. Whenever the goat gets about in a forest he eats up the sprouting trees, and in the course of time the forest disappears. It is quite probable that in very early times the islands were covered with forest, but that when human beings came in bringing with them goats, the result was that the forests disappeared. In Kashmir, where there are now considerable forests, one of our main efforts is to keep the goat at a distance. Thousands of goats come up from the plains of India to Kashmir in the summer to feed on the pasture, and our great difficulty is to keep them out of the forests. So perhaps the changes in the scenery of Greece may in some part be due to the depredations of the goat. Prof. Myres has added great illumination to the lecture, and he has helped us to understand still further the beauty of Greece. He spoke about the impression which Greece made upon us, and perhaps not unintentionally he likened us to wax! But we are not like wax. We do not all receive the same impression, and we *respond* to the impressions instead of receiving them impassively like wax. The impression which is made upon one individual is quite different from the impression made upon another. Each receives a different impression, and each makes a different response to that impression. Reference has been made to the altering conditions of the scenery in Greece—even of the Acropolis. On no two days is it the same, and we may also say that on no two days does any single individual look upon it in the same way. So, in observing and describing the natural beauty of the country, an inexhaustible field is opened up. Not only is the natural beauty continually changing, but the men who observe it are themselves changing from day to day. I am sure you will like me to thank Mr. Gomme for the way in which he has described to us wherein the beauty of Greece lies, and how we are to observe and describe it.

THE WORLD MAP BEFORE AND AFTER MAGELLAN'S VOYAGE

Edward Heawood, Librarian, R.G.S.

Read at the Afternoon Meeting of the Society, 11 *April* 1921.

FOUR hundred years ago, in April 1521, died Fernão de Magalhães, more familiarly known to Englishmen as Ferdinand Magellan, perhaps the greatest of the world's great navigators, the first to venture across the vast extent of the Pacific Ocean, and by so doing to virtually, if not actually, achieve the first circumnavigation of the globe. The man himself was worthy of the achievement, which was but the due reward of indomitable courage and determination, coupled with the highest seamanship and other fine qualities not always found united in the successful man of action.

In this paper no attempt will be made to deal in a general way with Magellan's life and voyages. This has been admirably done by Dr. Guillemard in his well-known Life of the navigator, while the original narrative of the great voyage by Antonio Pigafetta has been made accessible in the English versions of Lord Stanley and Prof. Robertson; and a considerable foreign literature on the voyage is also in existence. The aim of the present paper, rather hurriedly put together as in some sort a commemoration of the quatercentenary on April 27, is a more modest one, concerned chiefly with one special aspect of the voyage—its relation to the geographical conceptions of the age in which it was made. By a survey of the most important cartographic documents before and after the voyage, an attempt will be made to bring out, first the influence on Magellan exercised by the ideas of his time, and next the influence of the voyage itself on the cartography of the time immediately following.

In any question relating to a possible circumnavigation of the globe, the views and theories of the early Greek philosophers still exercised great influence in the Age of Great Discoveries. The sphericity of the Earth had been fully accepted by the best Greek thinkers from Aristotle onwards, and it was held to be quite a possibility to reach India by sailing west from the Pillars of Hercules. This teaching had been greatly obscured during the dark ages, when the crude idea of a habitable world surrounded by the ocean, such as is illustrated by the map of Marino Sanuto (1321) and by many others, held sway over the minds of churchmen and the general public. Still it had never been quite lost sight of. The size of the Earth had been calculated by Eratosthenes (about 220 B.C.) at 250,000 stadia, which on the basis of 10 to the geographical mile, gave an equatorial circumference only about one-sixth more than the true measure. The habitable portion, from Spain to the end of India, was reckoned by him as 77,800 stadia on the parallel of Athens, on which the circumference was reckoned as about 200,000 stadia; so that the proportion of land to sea

(or at least of the known to the unknown) would be about as $1 : 1\frac{1}{2}$. This estimate was in excess of the true length of the Old World by about one-third. It may be noted here that the estimate of the distance to be covered by sailing over the unknown portion might be vitiated in two ways—first by mistakes in the calculation of the size of the Earth, secondly by mistakes in estimating the proportion between the known and the unknown. Now the exaggerated estimates of Eratosthenes were abandoned by his successors, who fell into the opposite error. Posidonius (first cent. B.C.), followed by Marinus of Tyre (second cent. A.D.) and his copyist Ptolemy, reduced the circumference to 180,000 stadia, giving only 500 to the degree instead of the 700 of Eratosthenes. But while thus reducing the whole circumference (in fact as a direct result of such reduction) Ptolemy overestimated the extent of the land area in degrees of longitude (his degree representing only five-sixths of its true measurement), and the error was enhanced by the over-estimation of distances, even in stadia, by sailors and travellers. The longitudinal extension of Ptolemy's land area was thus fully 180° or half the circumference, from the Canaries to China, while it extended indefinitely beyond, since no termination was hinted at within the limits of the map. This representation of Ptolemy was of the greatest influence on the cartography of the time before Magellan.

On the revival by Columbus of the idea of the ancients that the east could be reached by sailing west (for it can hardly be doubted, *pace* M. Vignaud, that India was the goal kept in view from the first by the Genoese), these inaccurate ideas of the comparative smallness of the unknown ocean were even exaggerated by the acceptance of an Arab estimate of the size of the Earth, which seems to have reduced the length of the degree, as compared with Ptolemy's estimate, from $62\frac{1}{2}$ to $56\frac{2}{3}$ Italian miles. This gave a circumference only three-fourths of the reality.

Next, as to the political conditions between Spain and Portugal, which affected Magellan's great enterprise. The venturesome voyages of the Portuguese under Prince Henry's inspiration had made known the whole coasts of West and South Africa down to and beyond the Cape of Good Hope, as well as the Atlantic groups of the Azores and Cape Verdes, before the voyages of Columbus, and the political rights of Portugal had been confirmed by Papal Bulls, which gave to that nation by anticipation all the lands that might be discovered "usque ad Indos." When therefore Columbus returned early in 1493 with news of discoveries beyond the Atlantic, the Spanish sovereigns lost no time in applying for similar rights from Pope Alexander VI. Much misconception has prevailed as to the precise scope and character of the successive Bulls promulgated with this object during 1493, but the true position has quite lately been admirably demonstrated by a Belgian writer, Prof. H. Vander Linden. So far from representing the award of an arbiter between opposing claims, the Bulls were merely grants made at the instance of, and in terms suggested by,

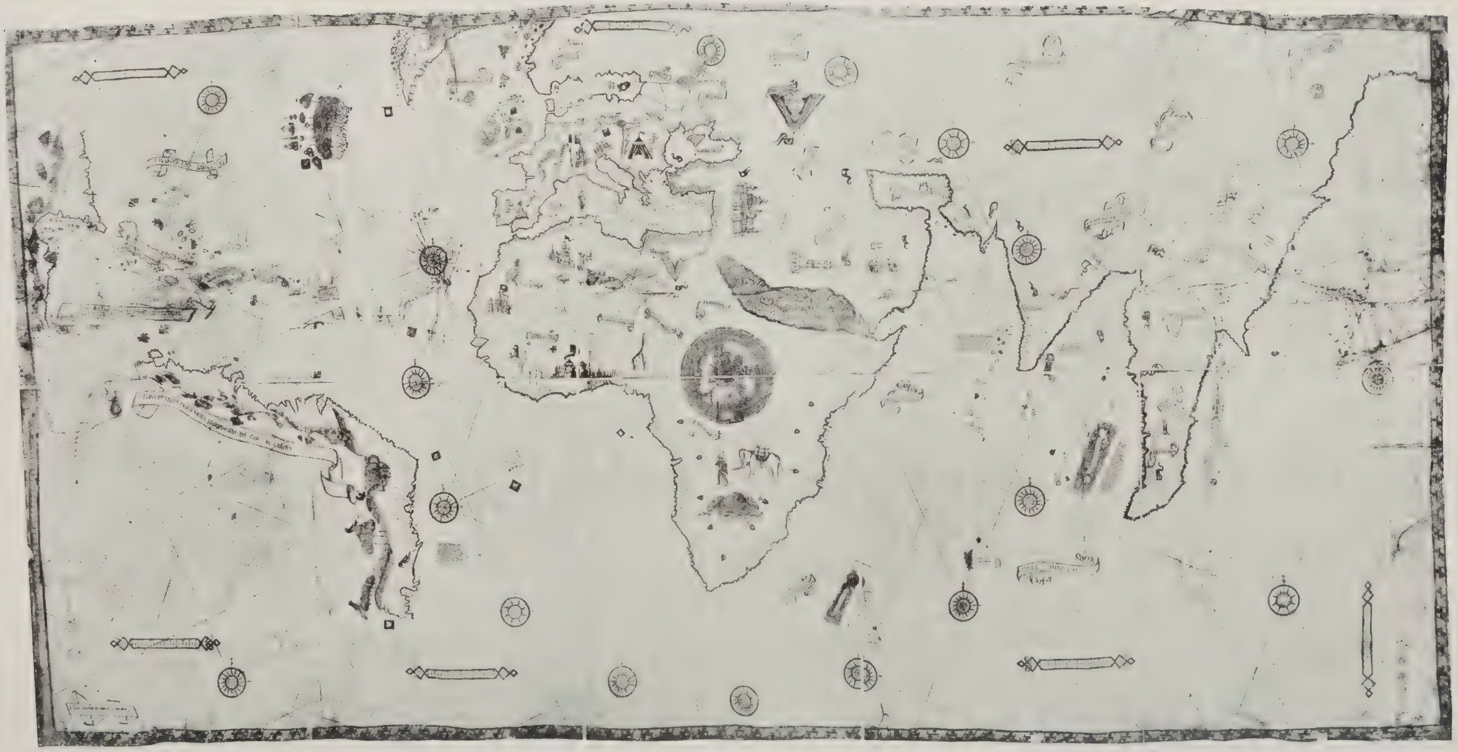
1. THE WESTERN HEMISPHERE, FROM THE INSET IN WALDSEEMÜLLER'S GREAT MAP OF 1507, SHOWING THE PACIFIC GREATLY REDUCED

(*From the facsimile by Fischer and Von Wieser*)

The left half follows Behaim (see No. 4).

2. PORTION OF THE CANTINO MAP, 1501–2, SHOWING THE LINE OF PARTITION BETWEEN THE SPANISH AND PORTUGUESE SPHERES

(*From the facsimile accompanying Harrisse's 'Les Cortereal,'* 1883.)



3. THE CANERIO MAP, 1502, FROM DR. E. L. STEVENSON'S REPRODUCTION (MUCH REDUCED)

The ten sheets of the original combined into one.

one party only—Spain—by a pope who was, for private and political reasons, entirely subservient to the Spanish sovereigns. The binding nature of the grants was never recognized by the other party—Portugal—and it was by independent negotiations, in which the pope took no part at all, that the final arrangement was reached by the treaty of Tordesillas, signed the next year, 1494.

In one only of the four Bulls of 1493 (the second in order of promulgation) was any definite line of demarcation laid down, and this, which seems to have been suggested by Columbus himself, was rather of the nature of a boundary to a Spanish preserve—not to be overstepped by any person not authorized by the Spanish sovereigns—than a line of partition. Its terms were ambiguous (though not perhaps much more so than those of many modern treaties of delimitation), the line being described as running from pole to pole 100 leagues (the league was then four Italian miles) west *and south* of any island of the Azores and Cape Verde islands. It is impossible to attach any definite meaning to a *meridional* line running west and south of a given point, but the intention is fairly obvious. Columbus was then already planning a second voyage, hoping to extend his explorations southward. On the other hand, Portugal had put forward an excessive claim to everything south of Cape Bojador, which it was important to frustrate. The expression "towards the west and south" occurs three times in the same paragraph of the Bull. In two cases its use is quite justified as it is a case of *discoveries* to the west and south, but it seems to have escaped the draughtsman, in his desire to insist on the point, that in the third case the phrase was not strictly applicable. The starting point also has been variously interpreted, but the intention evidently was to give a clear interval of 100 leagues beyond the furthest outlier of either group.

Thus, although the partition of the world between the two Powers has been popularly ascribed to the pope, the idea is not strictly correct. Neither did the pope effect such a division in 1493, nor did the line then laid down really take effect at all, for the only arrangement accepted by both sides was that of the treaty of Tordesillas, signed 7 June 1494 after friendly negotiations. In this, to meet the views of Portugal, the line was drawn, not 100 leagues west of any island of either group, but 370 leagues west of the Cape Verdes, with no indication which island it was to pass through. The intention probably was once more to give a clear interval of 370 leagues west of the whole group, but the ambiguity naturally encouraged conflicting interpretations later. Even now attention seems to have been wholly directed to the Atlantic side of the globe, and nothing definite is said about the application of such a line to the Antipodes. At first the way seems to have been considered open to either Power to acquire rights in the Indies by virtue of discovery and occupation, and it was only later that the Atlantic line was tacitly taken as to be prolonged through the poles to the opposite side of the world.

In order to understand the conditions which impelled Magellan to his great undertaking it is necessary to glance at the course of events between 1494 and 1517. The later voyages of Columbus and other Spanish captains to the western lands had revealed the fact that here was a new world stretching from north to south and blocking any direct maritime route to the East Indies by the west. Meanwhile the Portuguese under Vasco da Gama had already gained the great object of their ambition and under Almeida and his successor Alboquerque had firmly established themselves on the west coast of India, had taken Malacca, the great emporium of trade on the west coast of the Malay peninsula, and under Abreu had pushed on among the rich and renowned islands of the Archipelago. An important though not a pre-eminent part had been taken by Magellan in these great doings. A Portuguese by birth, attached in his young days to the court of the king, he had early opportunities of mixing with the sea-captains and other adventurers, and in 1505, at the age of about twenty-four, had sailed to the east in the fleet of the viceroy, Almeida. During seven strenuous years he had borne his share in battles and hardships, but though many times wounded had suffered no serious disablement. He formed a close friendship with one Francisco Serrão, who commanded one of the ships in Abreu's voyage to the Archipelago, and, being wrecked on the return voyage, made his way to the famed Moluccas or Spice islands, where he remained for the rest of his life. His letters sent hence to his friend Magellan told of the wealth of those parts, and no doubt were the means of turning the serious attention of the latter to the Spice islands as a field for enterprise. Returning to Portugal Magellan afterwards served in Morocco, was once more wounded so as to become slightly lame for life, and, after friction with his superior officer, had the misfortune to incur the displeasure of the king. Unable on this account to obtain any chance of distinction by further service with his countrymen, he took the step, no unusual one in those days, of offering his services to the King of Spain (the Emperor Charles V.), having already for some time nourished the idea that the true road to the Spice islands would be by the western or Spanish route. Getting his scheme adopted in the end, he set sail on 20 September 1519, and, after passing safely through untold dangers and hardships in the passage through his strait and the trackless Pacific Ocean, met his death in the Philippines, in a fight due to a tragic error of judgment, on 27 April 1521, leaving to his subordinate Delcano the task of bringing one of the ships, the *Victoria*, safely home to Portugal by the Cape of Good Hope.

We may now consider the current ideas of World-Geography in the years before Magellan's voyage in the light of the cartography of the time. The documents that have come down to us are unfortunately but a tithe of those almost certainly once existing, those we know having in many cases been saved only through a happy chance. For the years following the first voyage of Columbus, though Spanish maps must certainly have

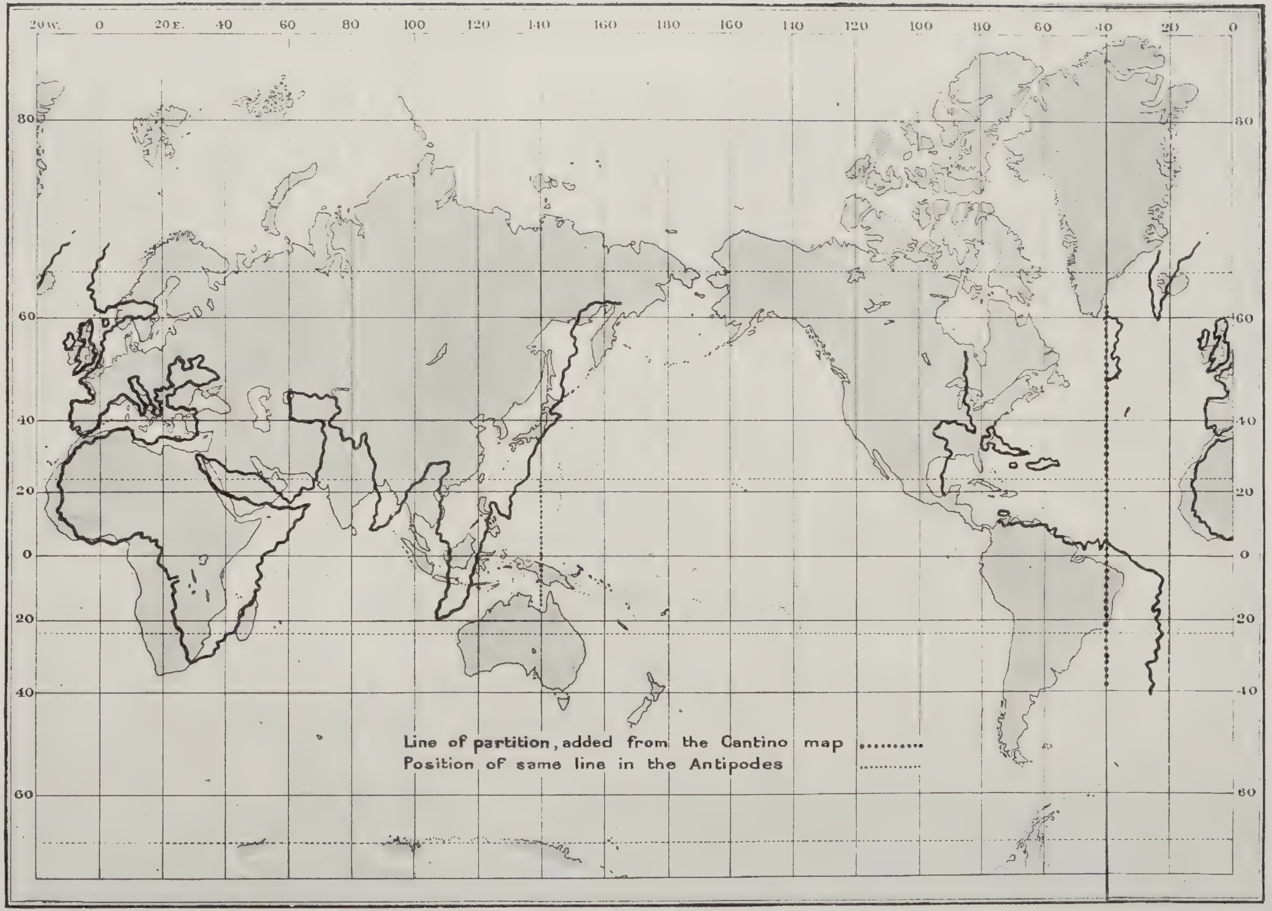
been made (and we have one most important one in that of Juan de la Cosa), some of the most striking maps known to us are of Portuguese origin. Before examining these we may glance at the maps current at the time of Columbus' great adventure and representing the notions accepted by him at his first setting out. They may be illustrated by a reconstruction of the so-called Toscanelli map, once thought to have supplied the main incentive to Columbus, but now considered to have had no connection with the Florentine astronomer, nor even to have been in existence at the date of the first voyage. It shows the whole space intervening between Portugal and the coast of China—in reality filled by the two great oceans and the whole breadth of North America—as occupying twenty-six spaces of 5° each—130° in all, in place of the actual 230°. Precisely the same scheme is to be found in Behaim's famous globe of 1492, of which Dr. Ravenstein's fine reproduction is exhibited in the Museum. In fact, the western part of the Toscanelli map has been reconstructed from Behaim. Behaim's representation of Eastern Asia is practically identical with that of Henricus Martellus, in the map of about 1489 preserved in the British Museum. Its most striking feature, reproduced in a host of later maps for over half a century, is the huge excrescence to the east of the Malay Peninsula, sometimes spoken of as a duplication of the latter, but really derived directly from Ptolemy, who, it will be remembered, drew a land-connection between eastern Asia and Africa, making the Indian Ocean a closed basin. It was now known that this was a mistake, but such was the reverence for Ptolemy's authority that his *Sinus Magnus* was retained and with it the further coast-line to the east, which Ptolemy had turned as it were on a pivot so as to run south and south-west instead of north and north-east. The eastern coast of this vast peninsula was now filled in by pure conjecture on the basis of Marco Polo, with the result that Asia—the longitudinal extent of which even up to the *Sinus Magnus* had been greatly exaggerated by Ptolemy—was still further extended eastward, leaving between it and western Europe the greatly diminished space already spoken of. That this representation marked a retrograde step is shown by the anonymous Genoese map of forty years earlier (1447), which, in spite of its generally crude construction, shows a far better apprehension of the geography of South-East Asia than many much later maps. A fine reproduction of this map is in the Society's collection. How the excessive extension of the old world held its ground even after the discovery of America is shown by the great map of Waldseemüller of 1507, and particularly by the inset map of the western hemisphere (Map No. 1). With America now intervening between Europe and eastern Asia, the space left for the unknown Pacific is reduced to a minimum—only 70° between the isthmus of Panama and the coast of China. In Ruysch's map of 1508 Asia is actually extended north-east to join the discoveries of Cabot and Cortereal in the North Atlantic.

Of the improved Portuguese type of map that of Nicolo de Canerio,

a Genoese working from Portuguese originals, may be taken as representative (Map No. 3). Its probable date was 1502, but its sources were no doubt rather earlier. The great progress indicated by this map is at once apparent. The new maritime discoveries in Africa, Asia, and America all find a place, and for the first time the Indian peninsula appears in something like its true proportions. One of the most striking innovations is the departure from Ptolemy's exaggerated estimate of the longitudinal extension of the Old World. As in other marine charts, there is no scale of longitude, but one of latitude is provided, and we may suppose the same scale applicable to the longitude on the Equator; in any case it was so understood by Waldseemüller, who inserted the longitude scale in this sense in his *Carta Marina* of 1516, itself in the main copied from Canerio. On this basis we find the length of the Mediterranean reduced from Ptolemy's 60° to only 35°, or actually some 5° less than the reality. This reform (not generally accepted till many years later) was offset to some extent by an exaggeration of the longitude covered by eastern Africa and Arabia, involving a serious displacement of the axis of the Red Sea. On the other hand, the extent of the rest of southern Asia is so curtailed as to occupy only 46° in place of Ptolemy's 77°, again actually 5° less than the reality. The total reduction from the Strait of Gibraltar to the Malay Peninsula amounts to fully 40°—from 155° to about 114°, the correct figure being about 109°. Canerio's is the first serious attempt to represent the Malay Peninsula as it really is, with Malacca correctly placed on its west coast, though he exaggerates its size and southward extension. The map ends to the east at a line through China, and there is no trace of the south-eastern monstrosity which deformed so many maps. (Yet we find Waldseemüller in 1516, even when copying Canerio, still marking Ptolemy's *Sinus Magnus* to the east, and an almost contemporary map also attributed to him still shows the huge peninsula, so long were the makers of maps obsessed by a once-accepted tradition.) By thus curtailing the length of the Old World, and discarding the imaginary prolongation of Asia as well as the great islands strewn by other map-makers in the ocean to the east, the Canerio type of map greatly extended the space left to be covered by the Pacific Ocean, the great size of which must by this time have begun to dawn upon the minds of both sailors and geographers. It was even unduly extended on the American side in the Canerio map by the eastward shifting of the east coast of Brazil, as compared not only with the reality, but with the representation on other maps of the time. The unknown portion, from the east coast of Brazil to the Malay Peninsula, is thus made 25° more than the reality—225° instead of 200°. The accompanying outline-maps show the conceptions of (1) Behaim and his copyists; (2) Canerio, in relation to the actual facts (Maps 4 and 5).

We have next to consider the line of demarcation by the treaty of Tordesillas, as drawn by the cartographers of the period. It is most

4. THE WORLD ACCORDING TO PTOLEMY, WITH BEHAIM'S ADDITIONS AND CORRECTIONS, COMPARED WITH THE TRUE CONFIGURATION



5. OUTLINES OF THE CANERIO MAP, 1502, COMPARED WITH THE TRUE CONFIGURATION

explicitly shown in another map of the Canerio type—that known by the name of Cantino, the representative in Portugal of Hercules d'Este, Duke of Ferrara, for whom Cantino had it drawn. This map, a fine reproduction of part of which, brought out by Harrisse in 1883, is in the Society's Library, shows the line (labelled "Este he o marco da ntre Castella e Portugall") as cutting South America just east of the more easterly of the two great estuaries on the north coast, perhaps intended for the Gulf of Maranhão. It is difficult to reconcile this position with the 370° leagues west of the Cape Verde islands, as indicated by the scale of miles, suitably corrected for the latitude of the group, the line being not far enough from *any* island of the same. However this may be, the line no doubt represents the position of the boundary as accepted in Portugal at the time, and it is very similarly shown in a later Portuguese map, belonging to the School of the Reinels, of which a coloured reproduction was published by Kunstmann in 1859. If we transfer it to the Canerio chart it falls, according to the longitude numeration supplied by Waldseemüller, in 334° east (or 26° west) of the Canaries, and its continuation on the opposite side of the globe would fall in 154° E., or about 30° east of the central line of the Malay Peninsula. We may see here, perhaps, an indication of political motive, both in the curtailment of the length of the Old World and in the eastward shifting of South America, the result being to bring a larger share of the new discoveries within the Portuguese hemisphere. In the more usual type of map, which long continued to hold its own, in academic circles at least, the line through the Antipodes would run well to the west of the Malay Peninsula, leaving both this and all the archipelago to Spain. Even in the Canerio type of map the Spice islands—the great object of attraction in the far east—would fall only a little west of the boundary-line, and Magellan, who claimed them as within the Spanish hemisphere, seems to have found some support for his claim in other Portuguese maps, even of the nautical class. The most important of these after 1502 (of those now known to us) were made by the Reinels, father and son, and their school. Opinions differ somewhat as to their importance, one writer—Denucé—placing them quite in the forefront of the maps of the time, while the verdict of others is less favourable. In any case they are the earliest known maps to show the results of the first Portuguese voyage to the Archipelago—that of Antonio d'Abreu in 1511, in which Magellan is said to have taken part, and we are expressly told by Argensola that it was by a map of Reinel's that Magellan explained his scheme of a voyage to the Spice islands by the west to the Emperor Charles V. The Reinels were summoned to Spain in connection with the voyage, and seem to have at least directed the construction of the charts taken on board the ships. It is somewhat strange that whilst Canerio had discarded the *Sinus Magnus* and eastern peninsula of Behaim and others, Reinel still retains them in his Atlas of the Indian Ocean (about 1516), from the sheets of

which a combined chart has been drawn in outline by Denucé. For the parts of the east actually visited by the Portuguese there is a distinct improvement on Canerio, *e.g.* in the representation of both Indian peninsulas—the more easterly (the Malay) now correctly cut off north of the Equator—in the shape and position of Sumatra, and in the insertion of Java and the train of islands to the east visited by Abreu. The longitude of southern Asia is still more correctly given than by Canerio, if we may suppose the latitude scale to apply also to the longitude on the Equator. The intervals between C. Guardafui and the Malay Peninsula (53°) and between the latter and the Moluccas (24°) are both correct within a degree or so, such accuracy lending support to the idea that longitudes had here been fixed by observations of lunar eclipses. Unfortunately, as no longitude numeration is given, it is impossible to say just where the line of demarcation would have been drawn by Reinel, all depending upon the longitude of C. Guardafui accepted by him. Another map, made by the Reinels a year or so later, shows further improvement, especially in the greater width given to India, the better shape of Arabia, and the nearer approach to a correct representation of the Archipelago. Map No. 6 reproduces a part of this.

The formidable nature of the task involved by a circumnavigation of the globe must by this time have become fairly apparent, though not yet perhaps quite fully realized. Whilst Columbus was constantly imagining the countries reached by him to be those of eastern Asia, it soon came to be recognized, with the progress of exploration in Central and South America, that an independent land mass—the Mundus Novus of Vespucci—blocked any direct sea-route to the East Indies by way of the west, though many maps continued to indicate a strait in the locality of the Panama isthmus. Quite early in the sixteenth century the coast of South America had been traced beyond the La Plata estuary, and no passage had been found, though the globes of Schöner of 1515 and 1520, with the geographical treatises issued simultaneously, have led some to believe that at least the entrance to Magellan's strait had been discovered before his time. The development of the cartography of South America between the voyages of Columbus and Magellan is well brought out by a series of small outline maps, given by Dr. Ravenstein in his work on Martin Behaim. They show the gradual extension of the coast southward so as to form more and more of a barrier to one wishing to reach the east by the west, and also the great exaggeration by the map-makers of the longitudinal extension of the continent, which reaches a maximum in the version of Bartholomew Columbus, who actually joins South America to the east of Asia. This supposed extension westward would give encouragement to a navigator proposing to cross the Pacific, as affording a coast-line which might be followed for a considerable distance across the unknown area. Thus in the rough sketch-map attributed to Leonardo da Vinci only quite a small distance intervenes

between South America and Asia. An improvement on any of these maps is again shown by one made by the Reinels about 1516, which clearly marks the entrance to the Rio de la Plata, and is an excellent specimen of the artistic work of its authors (see Map No. 7).

The globe-map of Schöner, already spoken of, supplies one of the chief arguments for the belief that the existence at least of Magellan's Strait had become known before the great voyage. The idea of such a strait is of course bound up with the belief in a southern land, which finds expression in various maps of the period. Such a land is shown, for example, in Leonardo da Vinci's map, though here it is placed much farther south than by Schöner. But the notion of an Antipodean continent, balancing, so to say, the known world of the northern hemisphere, dates back to a high antiquity, and recurs many times during the Middle Ages. It is to be found, *inter alia*, in the scheme of Pomponius Mela (first century A.D.). Some maps place a mythical southern land in the south of the Indian Ocean (possibly as an inheritance from Ptolemy). Such ideas had perhaps been fostered by imperfect knowledge of actual voyages to South America, and by the loose way in which the name Brazil (derived from the Brazil wood or verzino, known as a tropical product before the discovery of the modern Brazil) was applied to lands supposed to exist in the most widely separated localities. One of these was supposed to be not far from Malacca, whilst in the Lenox globe-map (one of Dr. Ravenstein's series) it is applied to the north-western extremity of South America. This is one of the maps showing a large land south of the Indian Ocean, and in the Cracow globe of about the same date (1511), the geography of which is in most respects identical with that of the Lenox globe, we have a strange instance of the confusion in some men's minds in the labelling of this supposed land as "America noviter reperta" (America lately discovered). It is worth noting perhaps that a somewhat similar confusion prevailed as to the part of the world reached by the French voyager, De Gonneville, some thinking that he touched at a part of South America, others that he had reached a new land in the Indian Ocean. Such confusion is further illustrated by the Association of parrots (specially mentioned by the early voyagers as found in Brazil, and prominently represented there on the Cantino and many other maps) with a vast land to the south of the Indian Ocean, where a legend recalling their great abundance is to be found in much later maps. Now when we find that the land south of Schöner's supposed strait likewise bears the name Brazil; remembering too that he was one of the academic rather than the practical school of map-makers; we can hardly give much weight to his representation as a proof of the knowledge of a strait, more especially as he places the passage some 7° N. of the true latitude of Magellan's Strait, in 45° instead of 52°. The idea of a strait giving access to the great South Sea had been in men's minds since the latter's discovery by Balboa, and when no such passage could be found within the

tropical part of America, it was not unnaturally transferred to the more southern region.

We come now to maps embodying the results of Magellan's voyage. The material is perhaps not so ample as might be wished, not only because some of the most important maps of the period have been lost, but because reproductions of some of those known are not generally available. One that is bound to be of interest in connection with Magellan is the large map by Juan Vespucci of 1526, or only four years after the return of the *Victoria*, brought to light by Messrs. Quaritch in 1914, and now in the possession of the Hispanic Society of America. The description published by Quaritch shows that it embodied the main results of Magellan's voyage, as might be expected from its author's official position in Spain as pilot and cartographer, but no reproduction of the map has yet been published. However, in the well-known Ribero maps of 1529, with the very similar map of 1527 sometimes attributed to Nuño Garcia of Turin, we have excellent examples of the official Spanish cartography during the decade following the great voyage. They were produced in the hydrographical office at Seville, established, according to some, largely under the direction of the Reinels, who seem for a time to have taken service under the Emperor. The accompanying Map No. 8 is a copy of the part of Ribero's map showing southern South America and Magellan's Strait. It could hardly be expected that the intricate navigation of the strait could be shown with greater accuracy, at least in a general map of the whole world. The left-hand portion of the map represents the Pacific, now first portrayed as a result of positive knowledge. The greater part is a mere waste of water, the only land seen for the greater part of the voyage being a few small islets, the chief of which received the names San Pablo and Tiburones ("I. of Sharks"). To the west of the ocean we see the Ladrones—the first landfall in that direction of Magellan as of so many subsequent navigators, and further still the eastern part of the Archipelago—representing the Philippines where Magellan met his death, the Spice islands with Jilolo, Banda, and Amboina, whilst in the other half of the map we have Timor, whence Delcano in the *Victoria* struck boldly south-west across the southern Indian Ocean to return to Europe by the Cape, and so complete the circumnavigation. This map is also important, as marking the line of demarcation through America, with Spanish and Portuguese flags on either side, and by the definite guide it thus gives to the position in which it would be placed on the other side of the globe in the view of the Spanish government. By this time the Portuguese were disposed to acquiesce in this view, and in 1529 (the date of this map) acquired the supposed Spanish rights to the Spice islands by purchase, though it was ultimately found that they were really Portuguese all through. On the accompanying sketch (No. 10) the outlines of Ribero's map are superposed on those of a modern map, showing that the width of the Atlantic was given

6. PART OF THE REINELS' MAP OF THE INDIAN OCEAN, CIRC. 1517, SHOWING THE RESULTS OF THE VOYAGE OF A. D'ABREU, 1511

The original extends somewhat farther east, and includes Jilolo.

7. PART OF MAP OF SOUTH AMERICA, BY PEDRO AND JORGE REINEL, CIRC. 1516

(*From Denucé's reproduction.*)

II. GORES OF A GLOBE DOUBTFULLY ATTRIBUTED TO SCHÖNER, 1523, SHOWING MAGELLAN'S TRACK, AND THE LINES OF PARTITION IN BOTH HEMISPHERES

This Globe is copied in Holbein's picture, "The Ambassadors," 1533.

(*From the facsimile in 'Johann Schöner' by Stevens and Coote*, 1888.)

almost correctly (except in the north), but that the extension of the Old World was somewhat exaggerated, that of the Pacific somewhat reduced. Still the general correctness as regards longitude is certainly all that could be expected.

Another Spanish map, that of Alonso de Chaves compiled at Seville in 1536 as an authoritative version of all the new discoveries, is unfortunately lost, though a lately found Portuguese map by Lopo Homem, eighteen years later, is thought to represent it somewhat closely. Most of the maps of this official Portuguese cartographer are also lost, but, as Mr. Abendanon has shown in the *Geographical Journal*, probably gave a far better representation of the Malay Archipelago than any Spanish map of the time, the cartographical results of Magellan's voyage being but few as regards that Archipelago, apart from general world-maps like Ribero's. The best maps of the time for this part of the world are the French specimens of the Desceliers school, possibly based on Homem's.*

The next map (No. 11) is in the form of gores for a globe found at Munich in 1885, and described by the late Henry Stevens and C. H. Coote. It is interesting as actually showing the track of the *Victoria* round the world, as well as the lines of demarcation in the east and west. For a time it was thought to represent the lost globe made by Schöner in 1523, only the year after the return of the *Victoria*, but it has been shown pretty conclusively by Harrisse to be not the work of Schöner at all, and to be probably of somewhat later date. On the other hand, it has been shown by Miss Mary Hervey to have been the globe copied by Holbein in his picture of the Ambassadors, painted in 1533, so it is certainly no later than this date. By adhering to the academic representation of the Old World in longitude, it brings the whole Archipelago and part of the Malay Peninsula within the Spanish hemisphere, showing the maker to have been very much out of touch with actualities. Yet he errs in good company, for, strange to say, the official Spanish cartographer, Alonso de Santa Cruz, in his well-known map of 1542, so extends South-East Asia eastward that his "meridianus partitionis" in the East actually cuts the coast of Bengal just east of the Ganges, placing the whole of Further India in the Spanish hemisphere.

Whilst Ribero confined himself to actual discoveries and thus left blank the whole of the Pacific area not covered by Magellan's track, it was otherwise with other maps of the time. If the belief in a southern continent prevailed as it did before the great voyage, it seemed to gain confirmation from Magellan's passage through his strait, the island of Tierra del Fuego being taken for merely the northernmost extremity of the

* By the courtesy of Messrs. Quaritch the maps shown at the meeting included an interesting and undescribed MS. chart of the Archipelago, based in part on Magellan's voyage, and marking the supposed spot in the Philippines (themselves designated by the name given by Magellan—Archipelago de San Lazaro) where he met his death. It is unsigned and undated, but may perhaps belong to the class of lost Portuguese maps to which Mr. Abendanon has drawn attention.

supposed continent, which looms out in a more and more imposing form in the maps of the next half-century. We can here mention one or two only. The double heart-shaped map by the French geographer Oronce Finé brings it prominently into view by reason of the projection chosen, and marks it as "Terra Australis recenter inventa sed nondum plene cognita" (the Southern land lately found but not yet fully known). A part is still labelled Land of Brazil and another Regio Patalis, a legend which some have thought a corruption of the Land of Parrots of other maps, but which seems to be an inheritance from much older times. The Pacific has nothing like its correct extension, only 100° intervening between Magellan's Straits and Jilolo next the Moluccas (it should be at least 160°)—one more instance of the slowness of academic map-makers to adopt the results of practical men. The southern continent also figures prominently in the group of maps of the Dieppe school, by Desceliers and others, in which the makers have given further rein to their fancy by joining it to the "Great Java" in the region where Australia was ultimately to be found. The excellent representation of the islands of the Archipelago may here be noted. The great Southland is also a marked feature in all the maps of the Flemish school—*e.g.* in the World-map of Ortelius, one of those in which the abundance of parrots on the Southland is specially mentioned. The parts north of the Pacific, too, long continued to offer a field for speculation, and the belief first expressed in 1508 by Ruysch that North America was but the continuation of Asia to the north-east held its ground long after Magellan's voyage. An instance is the map of the Italian cartographer Gastaldi, in which America and Asia are joined in quite low latitudes, as they were also by Finé. It was not till towards the end of the eighteenth century that the separation of Asia from America was finally established by Bering.

Magellan's voyage left in fact much to be filled in—the whole Australian region as well as the whole of the lands on either side of the Northern Pacific. In spite of this a fairly correct idea of the relative extension of land and sea had now been gained, and in this respect no decided improvement on maps like Ribero's was reached till the time of the French geographer Delisle, nearly two centuries after the great voyage.

Before the paper the PRESIDENT said: It is very meet that we should come together from time to time to celebrate the great deeds of those who have gone before us, and who have laid the foundations of our science. This afternoon we celebrate the fourth centenary of that great circumnavigator, Magellan. Mr. Heawood will not give an account of his great voyage, but he will show in what way that voyage affected the map of the world. I will ask Mr. Heawood, who has, at brief notice but with great care, compiled a paper upon the changes in the map before and after Magellan's time, to give us his lecture.

Mr. Heawood then read the paper printed above, and a discussion followed.

Sir BASIL THOMSON: It must have struck everybody, I think, in listening to the paper, how curious it is that so many of the voyagers in the Pacific

managed to miss the greater groups. Magellan took a course which was afterwards taken by many other voyagers, and if you look at the map of the Pacific you will see he could not have devised his course better if he wanted to avoid dangers and get to the Philippines. You have voyage after voyage from 1525 onwards. Some of these voyages were disastrous because the crews mutinied. In 1537 you have Grijalva: one ship out of the expedition managed to get to New Guinea. In 1542 you have Villalobos; in 1555 Gaetano, and there is rather a curious history about him. He was the pilot to Villalobos's expedition, and in 1555 he discovered Hawaii; it is so believed owing to the finding of an old chart which is marked with the words "discovered by Juan Gaetano." In 1565 Lopez de Legaspe discovered the route to the Philippines, and we really owe to the voyage of 1567 the remarkable fact it was possible in those days to run an annual galleon to the Philippines with almost the accuracy of a Pacific liner. The reason was this. When Mendaña set out in 1567 and discovered the Solomon Islands he took the same kind of course. He found the Solomon Islands and there came the fatal day in the islands when he called a council of all his officers and suggested that they should set sail westwards like the remaining ships of Magellan's expedition. The pilots voted against it. If they had sailed westwards, in all probability Mendaña would have discovered Australia in 1567. It was almost chance that he did not. He left the Solomons and tried to work to the south-east. Then the crew nearly mutinied, and he consented to go north. He crossed the Pacific far north of the line, and when eventually he reached California, within two days his second ship, long believed to have been lost, arrived at the same anchorage. Anybody who has knocked about the Pacific in a sailing ship will realize what an extraordinary feat that was. It was the sailing north that made it possible to run the galleon. You cannot get back under sail unless you go north and pick up a north-west wind on the way back. This voyage illustrates the vicissitudes of geography. After the discovery of the Solomon Islands the tavern talk was that the islands were full of gold. There was no foundation for this beyond the fact they had discovered some stone-headed clubs rich in pyrites. Eventually they persuaded the Government to fit out a fresh expedition in 1595. Mendaña had placed the Solomon Islands 1500 miles nearer to Peru than they really were, and he discovered the Marquesas and Santa Cruz, and when he got to Santa Cruz he came to the conclusion that the New Hebrides were the Solomons. He died there, and the expedition went away north of the Solomons. The Solomon Islands then began to travel almost all over the Pacific. I think they were identified with the Marquesas, and even Dalrymple in 1790 denied their existence as separate from New Britain. They were re-discovered in 1767 by a Frenchman, Buache, just two hundred years after they had been lost. It was very interesting that several people visited them, but it remained for the man at the study table, and not the discoverer, to identify them. Years after they had been re-discovered a Frenchman sat down and re-established the fact that the Solomons had been re-discovered two hundred years after they had been lost.

Mr. Glanvill Corney: As one who has experienced the thrill of handling some of the original documents written by men who sailed in the ships of Magellan's days, it is with particular pleasure, though not without much diffidence, that I avail myself of your invitation to add a few words to the very lucid and important paper which we have just heard from Mr. Heawood. I will refer only to one aspect of those discoveries, one which has reference not so much to the East Indies as to the Strait. For many years after Magellan had

passed through the Strait from east to west very little use was made of it, and not until thirty-seven years afterwards was it ever explored from west to east. But at that time Ladrilleros and another navigator or pilot called Ogea, whose manuscripts I have seen, were appointed to sail from Valdivia down the coast of Chile and Patagonia, and explore the strait Magalhães had discovered, from west to east. But it was very little used by shipping either from west to east or east to west for many years, although one or two expeditions were sent out from Spain to survey it. It was felt to be too remote, and its navigation was too dangerous. The climate was too rigorous, and the time occupied was such that the crews were very apt to be overtaken by scurvy, and altogether it did not serve the practical needs of the ships of that time ; so that at least four projects for facilitating the conveyance of people and merchandise across the isthmus of Central America were presently discussed. One route crossed from Nombre de Dios ; to Panamá one through the isthmus of Nicaragua and across the lake ; another through the isthmus of Tehuantepec ; and one from the north side of Darien to the gulf of San Miguel. But the more interesting point to which I would now refer is that it was really the discovery of Magalhães' strait, and the difficulties that were found to attend its passage by ships, that laid the foundation for the great modern triumph of engineering that we see to-day in the Panama canal in full working order. In 1527 steps were taken to clear the impediments in the bed of the Chagres river from its mouth up to the head of the navigable portion, which was a distance of about 12 leagues, and it was found that from that point to the coast on the Panama side involved a cart road of another 7 or 9 leagues. As an alternative to this plan proposals were submitted to the Emperor Don Carlos V. for the canalization of this track, and in 1534 His Majesty actually directed that the locality should be surveyed with that object in view—that a report should be drawn up and submitted to him setting forth the most suitable and economical means for establishing a communication between the head of the navigable portion of the river and the ocean on the west, the difficulties likely to be met with in executing such a work, whether on account of different tides, as was suggested by some people, or by reason of the irregularities in the surface of the land and its levels. His Majesty further called for a careful estimate of the expenses that the scheme to be most recommended would entail in men and money, and desired to be informed of the time that its execution might be expected to occupy. So that we have to go back to the year 1527 to get at the first suggestion for the construction of a canal across the isthmus of Panama ; and that was a direct result of Magalhaes' discovery. The despatch embodying these commands from the Emperor was dated 20 February 1534, and was immediately sent out to the Governor of Panama. The Governor at that time was Don Pascual de Andagoya, and he viewed this proposal with disfavour ; but while promising to see the orders of the Emperor carried out as far as practicable in the course of the ensuing spring, he considered that His Majesty must have been advised by counsellors of little talent, and persons who had no knowledge whatever of the local conditions or climate or topography. He even assured the Emperor that the world contained no prince, howsoever puissant, equal to the task of uniting the two seas, even with the aid of the native inhabitants of the country. Some persons deprecated the idea because, they alleged, the levels of the Atlantic and the Pacific were not the same ; saying that the first effect of a canal would be to flood the adjacent countryside. Fifty years later Padre José de Acosta, the historian of the Indies of that date, observed that be that as it might, it merely seemed to his poor ability that no human agency could suffice to break through

the mighty wild of rocky fastnesses and the impenetrable forests that God had set between ocean and ocean, and which had continued for untold ages to successfully resist the fury of their waves. What might the good Padre not have said could he have been present to witness, the other day, the passage of His Majesty's ship the *Renown*, bearing upon her decks the world's most puissant Prince, quitting the waters of the Atlantic to-day and entering those of the Pacific to-morrow!

Sir ALBERT GRAY: One of the sad experiences of advancing years is that we find what we were taught in our youth as facts become dispelled subsequently as myths and illusions. I had such an experience a week or two ago reading a most interesting book entitled 'Russia in the 'Eighties' by Mr. Baddeley, and there one of my illusions was dispelled. I had been told in my youth that in Russia wolves used to attack travellers in packs, and I remember well such a scene in a picture with the pack of wolves surrounding a sleigh and the unfortunate occupants tossing out their remaining food in order to get rid of the wolves. Now Mr. Baddeley comes along and tells us that this is a mere myth—that the wolves do not go about in packs, but roam in ones and twos. Mr. Heawood disperses another of those myths, and we now are told that it is entirely an error to suppose that the Pope Alexander VI., as an arbitrator, divided the world between Spain and Portugal by an imaginary line. One is rather loath to give up this illusion, but it seems to me there is just a trifle of reason in the foundation for it. One must admit that Pope Alexander did not act in the matter exactly as an arbitrator, his decision being given solely on the claim of Spain, and the awards to Portugal having been made by previous popes. Both the Portuguese and the Spaniards seem to have considered that to have a Papal Bull in your pocket was a fairly good title-deed. Accordingly first the Portuguese went to Rome, and obtained a Bull giving them all the discoveries as far as the Indies. Then the Spaniards came to Pope Alexander, and he gives them, apparently, the first Bull of 1493 confirming to them (under conditions) the discoveries of the Western ocean. Somebody seems to have brought it to the pope's notice immediately after the Bull was issued that this might interfere with the previous Bulls in favour of Portugal, and accordingly the very next day (if the Bulls were in fact issued on the dates assigned to them) the second Bull was promulgated fixing the 100-league limit, so although the pope gave those Bulls not as an arbitrator, but as a supreme authority, yet he was bound to consider that the various Bulls should not be inconsistent; and therefore he did what was the nearest thing to arbitrating between the two Powers, and fixed the 100-league limit. That decision, as we know, was unsatisfactory to Portugal, and the result was the Treaty of Tordesillas in the following year. I cannot claim to offer any observations on the actual history of cartography as has been so lucidly explained to us to-day by Mr. Heawood and in the speeches of my friends Sir Basil Thomson and Dr. Corney, but it occurs to me as an outsider how extremely probable it is that when an imaginary land gets on to a map it remains there for a long time before it is finally got rid of, and also that these various maps were probably not made in large numbers, and that in some cases the map-maker would know perhaps some only of the discoveries and not others. I only wish to thank Mr. Heawood most heartily for his most interesting and lucid paper.

The PRESIDENT: It made one's mouth water to see the series of maps which were put on the screen, and to note the number of blank spaces there were upon them which needed exploration. Nowadays there are very few blank spaces left, and we geographers are hard put to it to know where to go.

But four hundred years ago, in Magellan's time, one can imagine the joy with which those old sea captains put their heads together and thought over the great voyages which might be possible. To-day we would like to put once more on record the grateful memory in which we hold the magnificent services which Magellan rendered to geography. Mr. Heawood has well shown both what there was to be discovered, the amount of unknown sea and land in his time, and what his voyages enabled cartographers to fill in, and I am sure you would like me to thank on your behalf Mr. Heawood for collecting so many interesting facts regarding the great work of Magellan.

FOUR NOTES ON MAP PROJECTIONS

Read at the Afternoon Meeting of the Society, 14 *March* 1921.

Note on a Doubly-Equidistant Projection

Colonel Sir CHARLES CLOSE, K.B.E., F.R.S., Director-General of the Ordnance Survey

WE most of us know that when it is desired to ascertain from a small-scale map or atlas the distance between two points, the only correct way is to find from the map the latitude and longitude of the points and make a small calculation. But in practice, owing to the weakness of mortal nature, nobody does this, and we take a scale or pair of dividers and measure the distance between the points. It occurred to the writer that it might be interesting to acknowledge this human failing, and to choose a map projection in which the two straight-line distances between any arbitrary point and two previously fixed points should always be correct. The two fixed points may be, for instance, the starting and ending points of a voyage, and on such a projection, however the traveller may deviate from the shortest path, he will always be able to find, by direct measurement, how far he is from his home and how near to his goal.

It at once follows, from the definition of the projection, that the great circle joining the two fixed points is represented by a straight line true to scale throughout its length. Having drawn this straight line, the construction of the projection is easy: for each point of known latitude and longitude calculate the spherical or spheroidal distances to the fixed points, and the intersection of these rectified distances, measuring from the fixed points, will give the position of the required point on paper. The two systems of small circles, of which the two fixed points are the poles, are represented by concentric circles spaced at their true rectified distances.

In the special case in which the Pole of the Earth is one of the fixed points, the parallels of latitude are represented by concentric circles spaced at their true distances. The meridian passing through the other selected point is represented by a straight line true to scale throughout its length. As regards the other meridians, if the latitude of the other fixed point,

Q, be ϕ, and λ, L, be the latitude and longitude of any other point X, then, on the spherical assumption, the position of X on paper is found by the intersection of $90 - \lambda$ measuring from the Pole, with a measuring from Q, where

$$\cos a = \sin \phi \sin \lambda + \cos \phi \cos \lambda \cos L$$

L being a constant for any particular meridian.

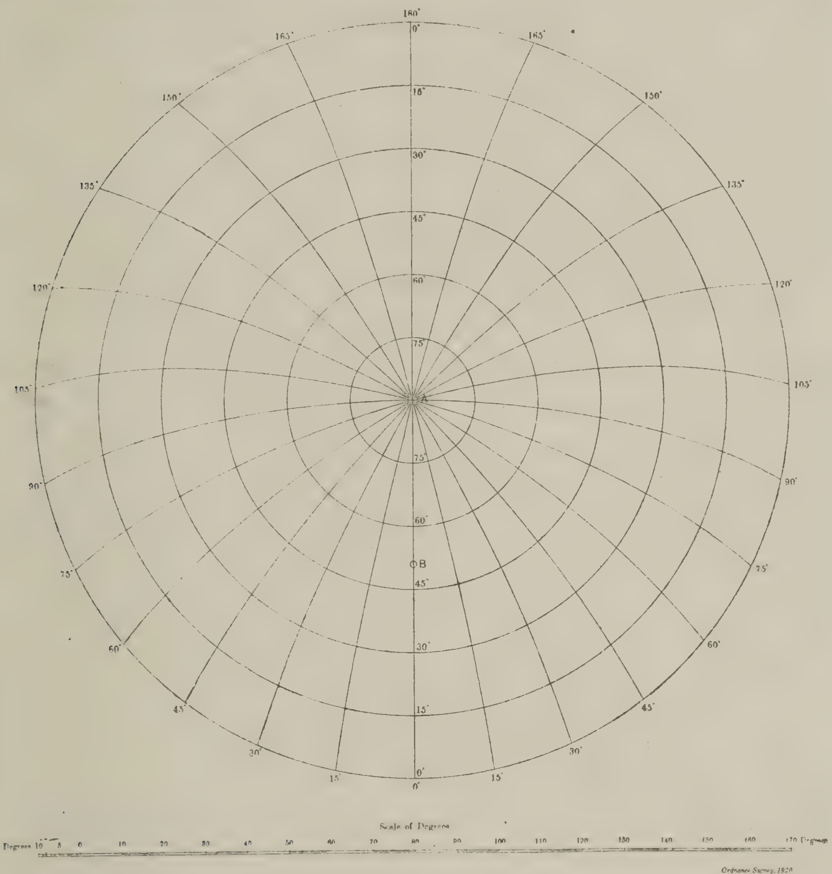


Fig. I.—Doubly-equidistant projection with centres A (North Pole) and B (London) 51° N.

Fig. I. shows a doubly equidistant projection with the Pole as one point and a point of latitude 51° N. the other.

Fig. II. shows a doubly-equidistant projection in which the two fixed points are New York and Land's End. By the use of this latter projection the traveller across the Atlantic can always obtain, by direct measurement from his map, the distances he is from these two places, however much he may be blown out of his course.

Reverting to Fig. I., by the use of this projection it is easy to solve graphically for any particular place, whose latitude is that of B, certain

elementary problems in spherical trigonometry. Thus, given the declination and altitude of a star, its hour-angle can be read off; or, by calling

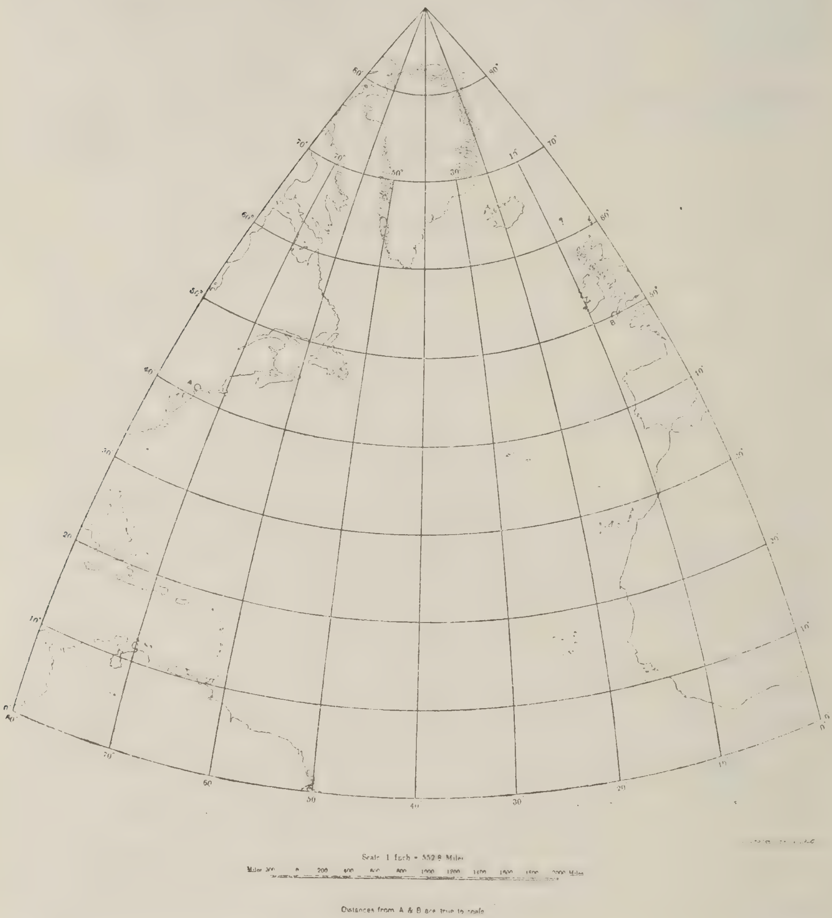


Fig. II.—Doubly-equidistant projection of the North Atlantic Ocean: centres A (New York) 40° N., 74° W., and B (Land's End) 50° N., 6° W. Distances from A and B are true to scale.

A the zenith, given the declination and altitude, its azimuth can be obtained, and so on.

On the Projection adopted for the Allied Maps on the Western Front

Arthur R. Hinks, C.B.E., F.R.S., Sec. R.G.S.

French military maps had always borne on their corners the rectangular co-ordinates referred to the Panthéon as origin, from which the use of the "grid" arose quite naturally. But as the projection employed was that of Bonne, in which meridians other than the central are not ortho-

gonal to the parallels, the system was ill adapted for the modern co-operation between survey and artillery. This defect was recognized very early in the war, and a new kilometric grid (carroyage) was introduced, for which extensive lithographed tables were provided, with the title "Tables de Projection (Système Lambert)."

On the unification of the Allied command in the spring of 1918, it was ordered that all the Allied armies should use the system of map reference based on this grid, and the minutiæ of its calculation became of immediate interest. Examination of the brief introduction to the French tables showed that they were computed from expansions limited to terms of the third order. The tables were to seven significant figures, and the preliminary quantities used in their construction to eight or nine figures. This degree of formal accuracy is of course far beyond the exactness of our knowledge of the figure of the Earth, and is purely formal, but at the same time essential. It is, however, very difficult, even with eight-figure logarithms, to reproduce a literal agreement with the tables to the last figure; and the slightest variation in the formulæ or the constants adopted produced discordances which, without being of real significance, were fatal to convenience.

Some accident which I cannot now recall made me interested in the subject during the summer of 1918, and with the assistance of Mr. A. E. Young I examined the discrepancies arising when the complete expressions for Lambert's Conical Orthomorphic projection with two standard parallels were used instead of the approximations of the French tables. This was with no intention of criticizing the French tables, which were accepted as definitive; the purpose was to show that it was necessary to use these tables as they stood, since independent calculation with the slightest variation of theory or constants could not reproduce them, or give results consistent with them. The results of this inquiry were not published, but a certain number of the pamphlet containing them were printed in June 1920 and distributed to those who might find the question of interest, if only historically.

In November last Colonel Bellot, director of the Service Géographique de l'Armée, very kindly wrote me a long letter which throws an interesting and unexpected light on the matter. The French "Système Lambert" was not intended to be precisely Lambert's Conical Orthomorphic with two standard parallels, but Tissot's projection of minimum deformation for a zone between parallels.

Tissot, remarks Colonel Bellot, has given the general formulæ of projections which possess, to the exclusion of all others, the double property of producing only alterations of angles of the third order and alterations of length of the second order. He could have pushed the developments further so as to reduce still more the alterations of angle, and even render them nil, but that would have complicated the equations without appreciable advantage. His general projection is then ortho-

morphic to the third order approximately. The equations contain two arbitrary constants which, with the position of the origin, are determined so as to reduce to a minimum the deformations of length over the extent of the surface to be represented. When this region has the form of a zone, if one determines the constants by the condition that the axis of *y* of the projection represents the meridian, and that the alteration of lengths is the same for all points at the same distance from the parallel through the origin, to the second order, one obtains precisely the equations of Lambert's conical orthomorphic projection limited to terms of the third order. That is why it has been called the "projection de Lambert." In reality it is not the Lambert projection, but only a projection very close to it.

This very interesting explanation not only clears up completely the questions which remained a little obscure, but makes it necessary for us to reconsider the view which has been taken in England of the work of M. Tissot. His 'Mémoire sur la Représentation des Surfaces et les Projections des Cartes Géographiques' (Paris: Gauthier-Villars, 1881) deduces from analytical considerations of the utmost generality certain formulæ involving two arbitrary constants, that have to be determined for any particular map by a process that looks tedious at first sight, and has not, as far as one knows, ever been applied to the construction of an actual map. For the particular cases of a zone and a "fuseau" M. Tissot shows that the formulæ are much simplified, but he does not, I think, point out that they reduce essentially to two well-known projections: the Lambert Conical Orthomorphic and the so-called Gauss Conformal. Still less does it seem to be generally realized that his general projection is to the third order of small quantities the same as the stereographic, as Colonel Bellot says.

Viewed in this light the projections of M. Tissot assume a new aspect, and it is clearly necessary to study them anew, and to master his rather repellent terminology, that seems so superfluously different from that of his compatriot Germain.* The interesting question will then arise: If considerations of a perfectly general kind lead to the conclusion that three well-known projections are, to the third order, equivalent to the best possible projections in the circumstances, is there any advantage in

* In the terminology of Tissot, Autogonale means orthomorphic, Authalique means equal-area, Aphylactique means neither orthomorphic nor equal-area, Automécoïque lines preserve their true lengths, Atractozonique projections preserve the areas of zones and fuseaux, though they are not authaliques.

Other unfamiliar terms are épicylindrique, épiconique, méricylindrique, tronconique, périgonal, périhalique, périmécoïque, which are more difficult to define briefly. When the terminology is mastered one speaks of Sanson's projection as the "méricylindrique à meridien moyen et parallèles automécoïques"; Albers' conical equal-area is the "tronconique authalique"; and Mollweide's is the "méricylindrique authalique à méridiens elliptiques." Perhaps the obscurity of this language is responsible for the fact that forty years after its publication the very interesting work of Tissot is not better known.

abandoning those projections nominally, in favour of close equivalents that have no clear geometrical significance? Shall we not conclude rather that the modern preference for the Conical Orthomorphic of Lambert, and the Gauss Conformal or transverse Mercator, is supported in the strongest way by Tissot's investigations, and that they may be employed with reinforced confidence under their habitual names? The idea that the Stereographic is the best projection for a map of equal extent in latitude and longitude is not, I think, supported by recent practice, but clearly requires examination.

The thanks of all interested in the subject will be given to Colonel Bellot for his very important explanation of the ideas underlying the "Tables de Projection (Système Lambert)," that were destined to play an essential part in the operations of the Allies, had not other causes precipitated the victory.

A Modified Rectangular Polyconic Projection

G. T. McCaw

The common rectangular polyconic is designed to give the scale true on the equator. The scale errors on the meridian and parallel, to terms of the second order, are:

Scale error in direction of meridian $+\frac{1}{2}\omega^2 \cos^2 \lambda$
" " " " parallel $-\frac{1}{4}\omega^2 \sin^2 \lambda$

where λ is the latitude and ω the longitude from the central meridian.

Now it is not difficult to reduce the scale error on the parallel. If the scale is made true on a parallel central to the map, instead of the equator, the scale error on the parallels generally will be reduced. But this is nothing but a partial improvement, since it leaves the scale error on the meridians unaffected.

It then becomes a question whether the scale error on the parallel could be brought up to the scale error on the meridian, thus making the projection orthomorphic; we could then reduce the scale error over the whole map by making use of a scale factor in the ordinary way. Now orthomorphism had been already obtained by Lagrange, whose projection had therefore to be investigated.

The Lagrange projection involves some elegant geometry, but it has peculiar properties. The projection, as regards scale error, is somewhat lop-sided, in that it introduces a scale error on the meridian and the line of zero error is a curve whose equation is not simple; this, however, is no fatal objection to a representation otherwise excellent. A point of even less importance in general is the fact that the northern and southern hemispheres are not symmetrical. Geometrically, the projection is not difficult to construct; but, as is well known, geometrical nicety of construction does not necessarily imply practical convenience for the map-maker; indeed,

experience proves rather the opposite. A good example is furnished by the rectangular polyconic itself: O'Farrell's construction is geometrically very neat, yet not of much practical value. The real objection, however, to the Lagrange is its lack of adaptability to the construction of general tables; each map demands a computation for itself. In fact, in this sense it is a better projection for the surveyor than the cartographer.

The writer was thus led back to the common rectangular polyconic. An orthomorphic form, indicated by J. I. Craig in another connection, was suggested to the writer by A. E. Young, and, suitably modified, proved fruitful. To explain this, some mathematical relations of the projection are unavoidable.

The equation of the meridians in the common rectangular polyconic is

$$\tan \tfrac{1}{2}\gamma = c \sin \lambda$$

where γ is the convergence or angle of the cone, and c is a constant *which must not involve the latitude*, though it may be any suitable function of the longitude. This c in the common form is $\frac{1}{2}\omega$ in radian measure.

Now supposing that we take

$$\tan \tfrac{1}{2}\gamma = \tfrac{1}{2}\omega \sin \lambda\{1 + \tfrac{1}{12}\omega^2(1 + \cos^2 \lambda)\}$$

we shall obviously have a projection which violates the condition above; we shall, in fact, have an orthomorphic projection which may be described as approximately polyconic.

Suppose, however, that in the term within the brackets we put $\lambda = \lambda_1$, where λ_1 is constant and equal to the latitude of the central parallel of the map, while λ outside the brackets remains unchanged; the polyconic condition will obviously not be vitiated. This, then, is the modification adopted. It leads to a rectangular polyconic which is approximately orthomorphic, and which is almost truly orthomorphic on the central parallel.

The scale errors on this modified polyconic are, to terms of the second order:

On the meridian	...	...	...	$+\frac{1}{2}\omega^2 \cos^2 \lambda$
,, parallel	...	...	...	$+\frac{1}{4}\omega^2(\cos^2 \lambda + \cos^2 \lambda_1)$

It remains to consider whether the modified projection can be set out from general tables. If xy, $x_x'y'$ be respectively the co-ordinates of the common rectangular and the modified rectangular projection, it is found that for the ordinates

$$y' = y\{1 + \tfrac{1}{12}\omega^2(1 + \cos^2 \lambda_1)\}, \text{ very approximately}$$

This contains λ_1 as a constant for the map, so that we may tabulate the fractional increase of the y of the common rectangular polyconic against the longitude as argument, and in the row representing the mean latitude of the map.

The main portion of the x co-ordinate is given in the column under longitude 0°, and is therefore the length from the origin measured on the

central meridian to the parallel of the latitude of the points. The remaining part of the x co-ordinate is the arc-versine of the point, that is to say, the offset from the perpendicular to the central meridian at the latitude of the parallel of the point.

Now in the modified rectangular this offset is found to be increased in the ratio

$$\tfrac{1}{6}\omega^2(1 + \cos^2 \lambda_1), \text{ approximately}$$

that is, the offset is increased in just double the ratio of increase of the ordinate.

It is evident, therefore, that it is necessary to tabulate a single modifying factor only, applied directly to the ordinate y and doubled before being applied to the offset, which is that part of the abscissa x which represents the arc-versine.

The following table shows the reciprocal of the scale error on the meridian parallel of the modified projection when the central parallel is in latitude 45°.

Lat.	15°		30°		45°		60°		75°	
Long.	Mer.	Par.	Mer.	Par.	Mer.	Par.	Mer.	Par.	Mer.	Par.
15°	31	41	38	47	59	60	115	81	430	109
20°	17	23	21	27	32	33	64	47	241	65
25°	11	15	14	17	21	22	41	31	154	44
30°	8	10	9	12	16	16	28	23	107	33

The exaggeration of scale can never be reduced by a scale factor. We give the preference to that factor which makes the scale error (positive) at the right and left margins of the map equal to the scale error (negative) on the central meridian, since this reduces the maximum scale error to the least possible. If ω_2 be the longitude of the margin of the map, reckoned from the centre, the longitude of the standard meridians will then be ω_1, where

$$\omega_1 = 0{\cdot}707\omega_2$$

In the example above, for a longitude of $25° = \omega_2$, we must then take $\omega_1 =$ 17° 40′. Accordingly, the reciprocal of the scale error now becomes—

Lat.	30°		45°		60°	
Long.	Mer.	Par.	Mer.	Par.	Mer.	Par.
0°	− 43	− 43	− 43	− 43	− 43	− 43
15°	+466	−404	−158	−147	− 68	− 90
17° 40′	+ 83	−182	0	0	− 87	−150
20°	+ 45	+ 74	+145	+179	−123	−435
25°	+ 21	+ 30	+ 42	+ 48	+1612	+121

The means of the errors on the meridian and parallel are found to be very nearly the same as the Lagrange projection. Compare the errors

with those in the common rectangular polyconic; it is sufficient to give the results for longitude 25°.

Lat.	30°		45°		60°	
Long. 25°	Mer. +14	Par. −84	Mer. +21	Par. −42	Mer. +42	Par. −28

Thus, while the modification here indicated reduces the scale error by nearly one-half, it at the same time has the effect of rendering the representation nearly orthomorphic.

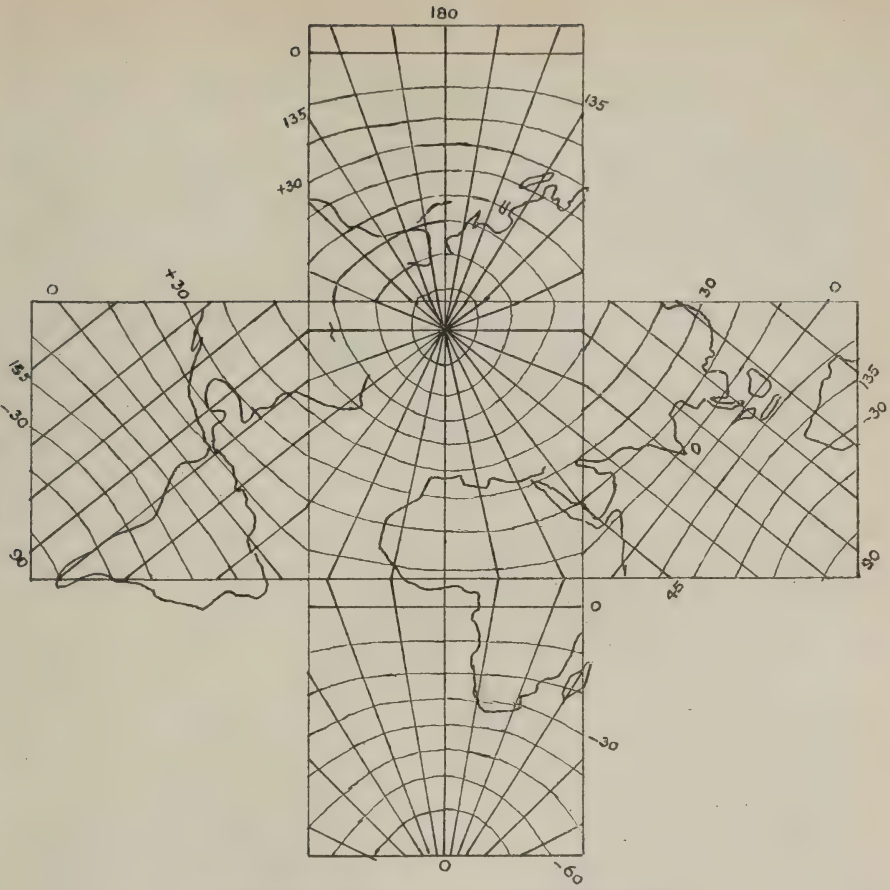
The modified projection is suitable for a meridional rather than a longitudinal configuration, but for areas whose total width does not exceed 40° of longitude it seems to be little, if any, inferior to the best forms of representation where the meridional extent is also considerable. The scale error is very much the same as that of the Transverse Mercator (Gauss Conformal). It would form an excellent projection for a general map of Egypt and the Anglo-Egyptian Sudan, or a country of similar proportions.

The Projection of the Sphere on the Circumscribed Cube

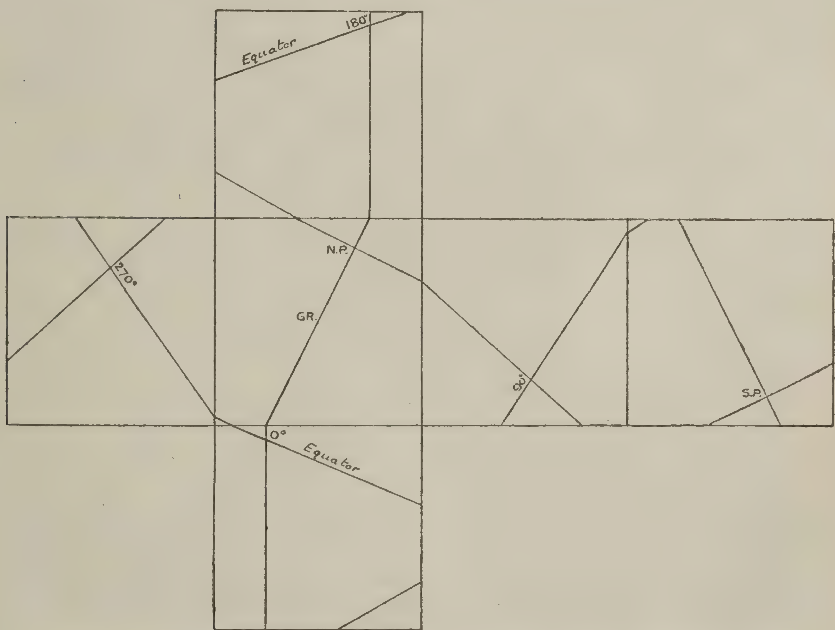
Arthur R. Hinks

The projection of the sphere on a circumscribed cube was, according to D'Avezac, first used by Reichard in a work published at Weimar in 1803. The poles were at the centres of two opposite faces. A small sketch of a projection on the cube touching the sphere at 30° N. and 100° W. was given by G. A. Schott in the Reports of the United States Coast and Geodetic Survey, Washington, 1882, and is reproduced in the writer's book on 'Map Projections' published by the Cambridge University Press, though by a regrettable oversight there is no acknowledgment of the source. In this example the meridian through the above point is drawn parallel to the edge of the face. Similar projections of the celestial sphere have been used by the writer for studying the galactic distributions of star clusters and nebulæ (Monthly Notices, R.A.S., vol. 71, p. 693). In all these examples the poles were placed in the median line of a face. It will be convenient to call this class the "inclined" projections on the cube, reserving the term "oblique" for the class in which the pole is not on the median line of a face.

The Washington projection referred to above cuts up the continents very awkwardly, and the same thing happens if one draws an inclined projection with London at the centre of a face. But by giving the cube a suitable obliquity it is possible to get a map of the world in which the principal land-masses are fairly well disposed on the faces of the cube,



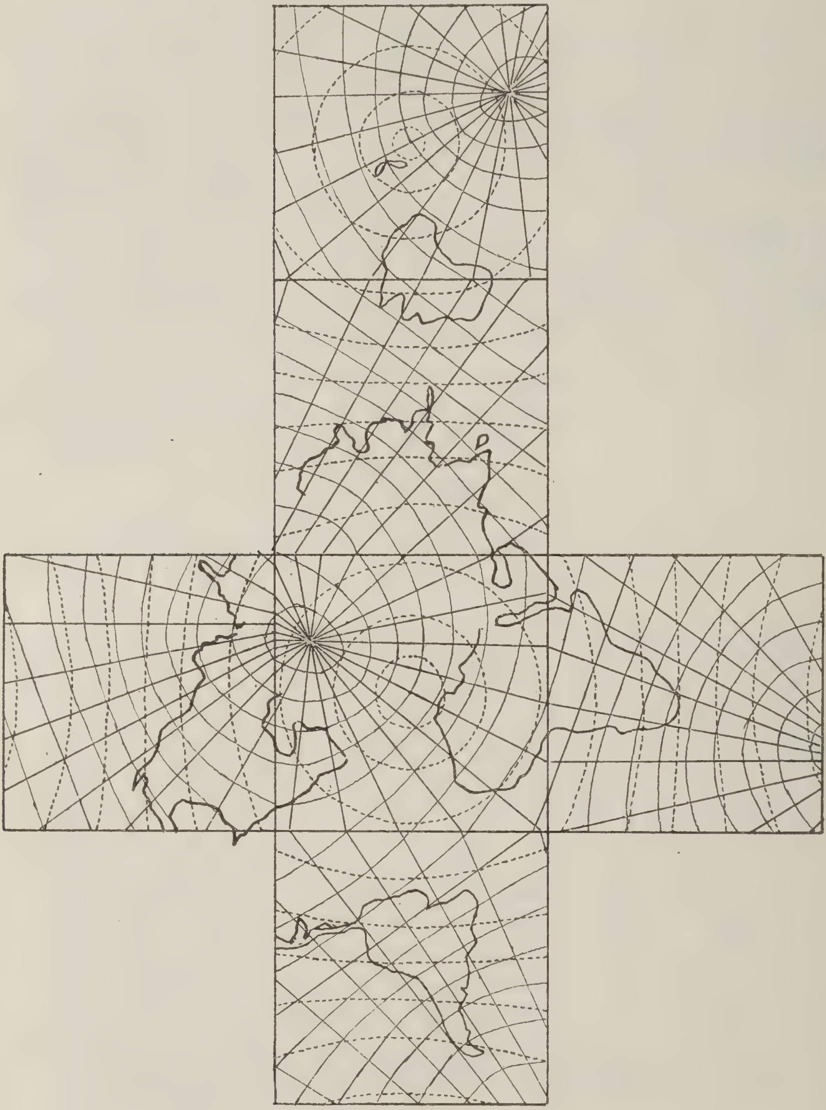
Projection of Earth on inclined circumscribed cube.



Preliminary construction of equator and meridians on oblique circumscribed cube.

as in the sketch below, which is, I believe, the first example of the world map gnomonically on an oblique cube.

The projection has some interesting properties. All great circles are



Projection of Earth on oblique circumscribed cube, with circles of equidistance from London at each 1000 miles.

straight lines on the faces of the cube; and a great circle which passes through the centre of one face is parallel to the edge of the adjacent face. Hence it is very simple to draw the great circle from any point of the world to the place which is at the centre of a face. It is also not

hard to draw the circles of equidistance from that place: they are shown dotted on the sketch.

The great circle joining any two points whatever of the sphere can be constructed quite simply, and the great circle distance measured, as is shown in 'Map Projections,' pages 42 and 46.

The accompanying sketch has no claims to accuracy, the meridians and parallels being constructed by a graphical process which is fairly simple to effect, but tedious to describe. The outlines of the land masses are roughly sketched to show that they fall well in relation to the edges of the faces. If the projection is ever redrawn, the north pole should be shifted a little more to the right, when the representation of Central America will be improved.

I do not know that such a projection has any very useful applications. The time has hardly come for laying out great-circle air routes. But it might be useful in showing the ranges of high-power wireless stations; and anyhow it makes a rather attractive little world map of an unusual kind.

Colonel Sir SIDNEY BURRARD: As I have no technical knowledge of this subject, I find it rather difficult to follow three of the foremost experts and to say anything of use. I can speak only from the purely map-making point of view. Sir Charles Close has put forward a new projection, and he has explained it with that lucidity which has characterized all his writings, but I did not realize until Mr. Hinks spoke of it that it was the beginning of a new class of projection. It will probably in future be known under the name of "Close's Projection." As far as I understand, Mr. McCaw has made a new modification of an old projection. I think he has introduced an arbitrary change, and I understand the justification for that is that he has reduced the errors. It would be very interesting to distant readers who are unable to be present this evening if, in dealing with his errors, he could also give them in terms of the errors we generally employ in mapping. We know we can plot to within one-hundredth of an inch, and draw a pencil line to within one-eightieth part of an inch, but I do not know what magnitudes of error Mr. McCaw was dealing with from the mapping point of view. With reference to his arbitrary change, when I have had to attend conferences on this subject I have met with certain projections which are called "quasi," and I have never quite known what "quasi" meant. One of our projections in India is called the "quasi," and our mathematical adviser told us that the mathematicians apply the word when they have been doing something which is not quite above board. As Mr. McCaw has introduced a modification, I thought I would take the opportunity of asking, "Is it 'quasi'?" Mr. Hinks greatly excited my interest when I saw he was reading a paper on the projection used by the Allies, but he did not tell us what was the solution of the problem—that the Artillery wanted a map covered with squares. Many years ago we were called upon to cover the Punjab with squares. If two lines on the surface of the Earth are parallel they cannot both be straight, and if they are both straight they cannot be parallel. Is the Artillery problem the same?

Colonel E. M. JACK: The only thing I would say is that it was not simply a matter of covering a map with squares, but providing a complete system of co-ordinates all over the area. We started with an arbitrary system of squares

based on each sheet, which was useful for identifying a point. What we wanted was a complete system of squares all over the area, independent of the sheets, and based on the system of co-ordinates.

Colonel Sir CHARLES CLOSE: Mr. Hinks mentioned the difficulty of finding an English name for "fuseau." I do not know if "gore" has been used.

Mr. HINKS: Yes.

Colonel Sir CHARLES CLOSE: Years ago I was serving on the Balloons, and we always called these things "gores." It is a possible word. I was very interested in Mr. McCaw's paper, and I should like to ask one question: Is the projection specially devised for a series of maps such as the ordinary polyconic, or devised for one sheet? At the bottom of the investigation is it intended to provide a series of sheets so that you may make up tables; or is it intended for one large sheet embracing the equator?

Dr. EVANS: May I ask if the word "lune" has been used?

Mr. HINKS: That again is a word which has never been taken on. It is the correct geometrical word, but it has never found favour.

Colonel H. ST. J. WINTERBOTHAM: I think, if I may make bold to do so, I will plunge into the gap left by Colonel Jack on the question of what the gunner really wants in the way of co-ordinates. The position of any heavy gun is properly surveyed on the ground. The position of the target to be hit is also surveyed. Those two positions are defined by rectangular co-ordinates, preferably in some projection which provides a minimum of angular distortion without introducing noticeable changes of scale. One wants, therefore, an orthomorphic system of co-ordinates, and the reference squares on the map should be defined by lines which are parallel to the axes of those co-ordinates. I will just add one word as to Mr. Hinks' most interesting paper on the Lambert Conical Orthomorphic. I think it is a very curious thing we never understood in France that the projection actually in use was due to Tissot. When British and French troops were despatched to Italy in 1917 the British troops were without equipment for either survey on the ground or reproducing maps, but were fortunate enough to secure in Paris a large number of French squared maps which had been specially prepared for that front. We found out then that the French intended using there a Lambert Conical Orthomorphic projection with one standard parallel. From that day for two months the French representative of the Service Géographique in Italy and myself saw little of each other. During these months the French, ourselves, and the Italians all computed the positions of the geodetic points in the Venetian Plain upon Lambert's Conical Orthomorphic with one standard parallel, and each worked on first principles. It was naturally rather pleasant to find at the end of it we had come to no substantial disagreement, but all of us, in that case, regarded it as a Lambert Conical Orthomorphic.

Lieut.-Colonel A. J. WOLFF: The projection described by Mr. McCaw is very ingenious and interesting. During the war, partly owing to the lead of the French and partly on account of the claims of the artillery, orthomorphic projections attracted considerable attention. Orthomorphism is however only local on a map. Is it therefore worth while to strive after approximate orthomorphism at the expense of other definite properties and simplicity of construction? What Mr. Hinks has told us about the French map projection is exceptionally interesting to me. When we were scoring the Lambert grid on our war maps in 1918, the slight difference from the formulæ of Lambert's second projection puzzled me considerably, and the explanation given by Mr. Hinks comes as a complete surprise to me.

Colonel TANDY : Sir Sidney Burrard has referred to our difficulties in India. The General Staff wanted us to extend one system of rectangular co-ordinates indefinitely all over India, or at all events over the whole of the North-Western Frontier. This is impossible, and the only system I was able to suggest for all India was to use our degree-sheets, which are bounded by one-degree graticules, as a basis, and then to subdivide these into minutes and decimals of a minute. I do not know if the question has been decided in any way since I left India, but it is very likely to be heard of again, and if experts present will turn it over in their minds we may be very glad of their advice later on.

Mr. REEVES : Sir Charles Close's new projection is likely to prove very useful in many circumstances, and in my work of instruction I welcome it as providing a ready means of solving approximately problems in spherical trigonometry. It is important to be able to check readily the computations of pupils, and see that they are not committing any serious errors with their work; as, for instance, in the computation of the hour angle from an observed altitude. For this purpose I frequently use, at present, a large globe or a special arrangement of two similar projections, the upper one of which is transparent and revolves on the other; but this new projection would, I imagine, be better in many respects. What is needed now is that some one should work out the co-ordinates of the projection for a few of the more useful cases, so that a draughtsman could easily and accurately construct it to any scale.

Mr. McCAW : With regard to Sir Charles Close's question, the custom in the Geographical Section of the War Office has always, I think, been to limit the rectangular polyconic projection to a single sheet of a small-scale map. When the scale is comparatively large, say 1/250,000 for serial maps, there is no appreciable difference between the common and rectangular polyconic. Sir Sidney Burrard has asked if the projection I have described is a "quasi." That is not so; but after all I do not think there is any great objection to the use of this word in general, provided that its meaning is properly understood. A name like secant conical is descriptive merely, but to prevent any one from supposing that points on the sphere are projected orthographically on the secant cone, the qualifying word "quasi" or "so-called" is often added. The projection of which I have spoken remains rectangular and polyconic after modification, and no qualifying word is wanted. I should like to take advantage of this opportunity to ask a question as to the cadastral sheets of India. In that vast country, at least six origins of cadastral systems would be required. But the Indian Survey went further and made an origin, as I understand, at the centre of each square degree. I should like to know whether or not this is the case, and whether the cadastral sheets are square.

Colonel TANDY : All our cadastral maps in India are based on rectangular co-ordinates, and have rectangular sheet-lines. The work is generally done by districts at the time when the districts come under settlement, and separate origins are usually taken for each district.

Colonel Sir SIDNEY BURRARD : One question I forgot to ask Mr. McCaw. I understand his new projection is only for a width of 40 degrees in longitude. If you extended it beyond 40 degrees in longitude, will the errors show less favourably in comparison with the polyconic?

Mr. McCAW: I am sorry that I forgot to answer one of Sir Sidney Burrard's first questions, of which the present question is really an extension. Perhaps the best answer is this: The tables of the common rectangular polyconic which we use at present, computed by Major L. Darwin, R.E., cover 20° or 30° of longitude. With the new tables it will be possible to extend the longitude

to some figure approaching 40° without increasing the average error. The errors of all polyconics increase with the square of the longitude from the central meridian. By securing approximate orthomorphism, however, we get nearly rid of the error of bearing round a point, and we obtain the further advantage of being able to employ a scale factor, thus reducing scale error. Since the errors in the common rectangular polyconic are both positive and negative, the application of a scale factor would introduce no improvement.

The PRESIDENT: I am afraid I cannot pretend to have understood every single word uttered this evening. There have been some very ugly words uttered by Mr. Hinks; but I dare say he viewed them with repugnance. We all of us grasped Sir Charles Close's idea, and also have realized the practical value of it if it could be translated into effect, and we all wish to thank these gentlemen for having brought forward this subject of projections.

MOUNT EVEREST EXPEDITION

WHEN the President announced on January 10 that permission had been received for the Expedition to enter Tibet this year, he said further that the passes would be open about the end of May; and it was afterwards planned that the Expedition should assemble at Darjeeling towards the middle of May with the intention of moving on the 14th, or some day closely following, according as the news might be good or bad of the condition of the Jelep La, the pass leading into the Chumbi Valley. There had been some fear that delay in the passage of the ships carrying one or two members of the Expedition might interfere with the punctual start. It is, however, satisfactory to learn from a Reuter's telegram that the main expedition was to leave Darjeeling on May 18 and 19, within four days of the earliest possible. The surveyors had left a few days before with the intention of proceeding by the Tista Valley, and were to join the main party at Kampa Dzong.

The Surveyor-General of India is very anxious to make a strong connection between the triangulation of India and the surveys to be executed north of the range on the upper waters of the Arun and on Tingri Maidan. It would seem that the Tista Valley provides a straighter connection for this triangulation, as indeed it would have provided a shorter route for the whole expedition. But the road in the Tista Valley is so bad that it was judged preferable to take the main party a longer as well as a much healthier way round.

The Expedition this year has always been spoken of as a reconnaissance, and it is important to make clear at the start that it is hardly expected that the climbers will reach the summit, or any extreme height on the mountain in the present season. The instructions to the Chief of the Expedition, after laying down that the aim of the expedition is the attainment of the summit of Mount Everest, and that all activities should be made subordinate to that supreme object, proceed as follows: " For the

present year the main object is reconnaissance. This does not debar the mountain party from climbing as high as possible on a favourable route, but attempts on a particular route must not be prolonged to hinder the completion of the reconnaissance." In other words the climbers will go as high as they can provided that they are thoroughly satisfied they are on the best route to the summit, but it is essential that by the end of the present season there should be no doubt which is the best route. When one considers that the surroundings of the mountain are completely unknown, it is pretty clear that the complete reconnaissance is likely to occupy very fully the whole of the present season, and that only exceptional good fortune, and rather easier conditions than are probable, can allow the leader of the mountain party to rest satisfied that of any possible routes he had chosen best, and still to allow time for a serious attempt to reach the summit this year.

There is, however, excellent ground for hoping that at least two new records may be established. The highest camp yet made is Mr. Meade's on the saddle of Kamet, about 23,500. The highest point reached by any climber is about 24,600 by the Duke of Abruzzi and his guides on Bride Peak. It would not be over-sanguine to think that in the course of this year the Mount Everest Expedition will have a camp higher than Mr. Meade's, and have reached a point higher than 24,600. For no expedition has ever before worked in conditions that promise so well, or with a party so thoroughly organized.

In view of the desire of all members of the Society and of the Alpine Club to receive the earliest possible and fullest information during the recess, when there will be no meeting at which announcements can be made, the Committee have arranged that long cablegrams and news letters shall be dispatched as occasion allows every week or ten days for publication in the *Times*. These cablegrams are the copyright of the Mount Everest Committee, but may be copied twenty-four hours after publication with the usual acknowledgments. It is hoped also that a considerable number of photographs will be received by mail from the expedition, and a selection of these will be made available for the illustrated papers. All the photographs as they arrive will be shown in the photograph room of the Society; and in the map room a map will be displayed showing as far as possible the progress of the expedition. The topography of the whole region being almost unknown, there is likely to be considerable doubt at first in the interpretation of cablegrams, but it is hoped that in the course of the summer preliminary copies of the maps of the survey party will be received, and these will be shown as they arrive.

REVIEWS

EUROPE

Coal in Great Britain.— **Walcot Gibson, D.Sc.** London: Edward Arnold. 1920. Pp. 311. *Maps and Illustrations.* 21*s.* *net.*

Coal.— **J. H. Ronaldson.** London: John Murray. 1920. Pp. 166. *Maps and Diagrams.* 6*s.* *net.*

THE first of these volumes is a general text-book on the origin and nature of coal, with special reference to its occurrence in Great Britain. It is an excellent book, clearly written, well illustrated, and supplied with an exhaustive index, but it has no references to larger and more specialized works. Dr. Walcot can be congratulated on having written a useful volume which should make a wide appeal to mining students and engineers.

The small volume by Mr. J. H. Ronaldson is one of the Imperial Institute Monographs on Mineral Resources. It is encyclopædic in its brevity and the number of facts and figures which it cites, but that is in keeping with its object as a work of reference. The monograph covers the coal deposits of the whole British Empire. A useful bibliography is added.

The Making of Europe.— **W. H. Barker and William Rees.** London: A. & C. Black. 1920. Pp. viii. + 298. 6*s.*

This book may be emphatically and unreservedly recommended, not only to teachers of geography and of history, but to all and sundry—not excluding, in the Scotticism, the sapient scribes who daily in the penny papers instruct us on the political and economic problems and personalities of Europe; for it presents a geographical treatment of the historical development of Europe from the invasion of the Huns to the present day. The book is equally satisfactory in matter, method, and make-up; indeed, for its price it is a better turned-out book than anything of its kind that we have seen for many months. The selection of material is at once useful and catholic, and its presentation is quite admirable. There is no affectation of omniscience, no splitting of straws, no forcing of points. Many interesting minor influences are ignored, for the aim of the book—quite rightly—is to give broad outlines and a wide outlook; but essentials are never ignored, and are presented convincingly.

The book is really, though not in actual arrangement, divided into three parts, dealing respectively with: I. Early and Mediæval Europe; II. Modern Europe from 1789 to 1878; and III. Economic Europe from 1878 to 1920. The parts are approximately equal in size, but cover, of course, respectively *c.* 1400, 100, and 40 years. The rapid sketching of the first part is, however, entirely satisfactory, providing every vital foundation for the full discussion given to the French Revolution and its sequels. In each part the widest interpretation is given to the word "Europe," *e.g.* two chapters in Part III. deal with "World Problems" generally and "The Middle East" particularly; and everywhere there is the most careful co-ordination of the geography and the history, illustrated by black-and-white maps and diagrams of the greatest value —clear, ingenious, and suggestive.

Each chapter ends with a Recapitulation and a set of Questions; and the latter cannot be answered by merely looking up a certain section of a certain page, but are a real test of the meaning rather than the mere statements of the chapter.

It is a pity to use *watershed* nowadays in the sense of *water-parting* even if originally derived from the same root as *scheiden* "to part."

L. W. L.

ASIA

Review of the Civil Administration of Mesopotamia.— Miss Gertrude L. Bell, C.B.E. London: H.M. Stationery Office. 1920. Pp. 149. 2*s. net.*

Perhaps Blue Books and White Papers have acquired their reputation for dryness unjustly; but it is a commonly accepted belief that the information they contain, though undeniably valuable, is so unattractively presented as to preclude any ordinary man or woman from digesting it. In this White Paper (a substantial volume) by Miss Gertrude Bell, whose name, by virtue of her travels, is well known to all students of Middle Eastern affairs, we have a striking departure from the old traditions. Nor is her book less remarkable for the matter it contains than for the manner in which this is treated. When news was received last summer of "regrettable incidents" in Mesopotamia and a general state of chaos throughout the country, the British public became concerned as to the Government's policy, and correspondence in the Press revealed a rather remarkable ignorance of British activities apart from military operations. It is with the civil administration that Miss Bell deals, and although the period under review includes the years during which Mesopotamia was an important theatre of war, she keeps military history very properly, and very skilfully, in the background.

In any opinion on the efficiency of British administration in Mesopotamia comparisons must inevitably be drawn between the new order and the Turkish *régime*, especially as it was considered advisable, in the initial stages of our occupation, not to destroy the old system root and branch, but rather to cut out the tangle of weeds and ingraft reforms gradually. As we read this Review and observe these reforms in process of growth, it becomes abundantly clear that the most formidable difficulty with which our administrators were faced was the cumbrous inefficiency of the old system of "government by sedentary officials according to minute regulations framed at Constantinople for Western Turkey." We learn on the first page: "It is not too much to say that the Mesopotamian Wilayats of Basrah, Baghdad and Mosul had reached the limits of disorder consonant with the existence, even in name, of settled administration." And again: "Instead of utilizing the power of the shaikhs the Turks pursued their classic policy of attempting to improve their own position by the destruction of such native elements of order as were in existence. . . . To recognize local domination and yoke it to his service lay beyond the conception of the Turk, and the best that can be said for his uneasy seat upon the whirlwind is that he managed to retain it." Such was the status of authority in the country in which, side by side with the conduct of military operations on a large scale, we had to organize and set in motion a system of administration: a task the difficulty of which is only equalled by the extraordinary interest of this story of its fulfilment.

In the second chapter of the book a clear idea is given of the framework of British reform, to which the details were added later, and in the three succeeding chapters we watch the gradual application, and the working, of our adminstrative measures in the ever-increasing area under our occupation. It is these chapters that Miss Bell, with unobtrusive art, interweaves with brightly coloured threads of local history and ethnology, of which she speaks with an authority probably unequalled. By the exercise of a humour, and a gift for anecdote, as refreshing as they are unexpected in a White Paper, personalities, situations, and the mentality and mode of life of the tribesmen are portrayed with a skill which is remarkable. As an instance may be cited the passages dealing with the Holy Cities of Karbela and Najaf, where the perplexing inter-

play of politics, religion, and fanaticism, together with the feverish mentality of some of the prominent inhabitants, are vividly depicted.

The seventh and two succeeding chapters of the Review comprise an account, prolific in facts and figures, of the Revenue, Judicial, and Financial Administrations, with their subordinate departments. The last chapter will prove of supreme interest to many readers, for it gives a full account of the Nationalist movement in Mesopotamia and of the causes of the serious trouble of last year. The summary of political conditions at the end of the war and the explanation of the gradual change of sentiment in the country, together with some revelations as to the men behind the scenes, will throw a new light on a situation which has suffered from considerable obscurity ; and grave as the disorders were, Miss Bell's account will do much to counteract the depressing conclusions which they suggested at the time. That alone would be a result worth attaining : but the book will also perform an invaluable service in putting on record the work accomplished by the British Administration in Mesopotamia during the last six years. Miss Bell is to be congratulated on her fascinating report. H. B. R.

Through Central Borneo : An Account of Two Years' Travel in the Land of the Head-Hunters between the Years 1913 and 1917.— Carl Lumholtz. 2 vols. New York : Charles Scribner's Sons. 1920. *Map and Illustrations. Price* 42*s. net.*

The author of these volumes is well known as a zoologist and chiefly an anthropologist, from his travels and investigations in Mexico during several years and earlier in Queensland. In 1913 he projected an exploring expedition to New Guinea, " the promised land of all who are fond of Nature and ambitious to discover fresh secrets." It was "a Norwegian undertaking," but it was assisted by grants from, among other bodies, the Royal Geographical Society. Intending to employ Dyaks as his carriers and helpers, he proceeded first of all to Borneo to engage them. The outbreak of the Great War, however, necessitated the abandonment of his plans, as it frustrated so many another project. Till the return of better days Mr. Lumholtz decided to turn his attention to an exploration of Central Borneo, "large tracts of which are unknown to the outside world." The ethnology rather than the geography of the country appears from his narrative to have specially claimed his observation.

Borneo, which contests with New Guinea the distinction of being the largest island of the Globe (apart from Australia and Greenland), is heavily forest clad, and drained by large rivers rising in the central highlands, some of them deep enough to be navigated by steam launches of considerable size for some 300 or 400 miles. The island possesses a humid climate and a temperature rarely oppressive. The author's experiences led him to consider Borneo to be " quite pleasant and probably less unhealthful than most equatorial regions, particularly in the central part where malaria is rare and prickly heat does not occur." The country is rich in valuable timbers, and excellent wild fruits ; it possesses a vast and magnificent flora, and its only very partially discovered zoological treasures are remarkable for number and peculiarity. Mr. Lumholtz believes that the Chinese were the first to make discovery of the island, but that it received its earliest colonists from the Hindu kingdom of Madjopahit in Java. These introduced Hinduism, tinged with Buddhism, and that in turn had to give way to Islamism, now the widely recognized religion among those who inhabit at least the sea borders of the country and river-banks in touch with the outer world. The autochthonous inhabitants of the interior remain pagans.

Magellan's expedition in 1522, by which the island was spoken of as 'Bornei,' brought to Europe its earliest knowledge of this splendid province of the world. By 1906 the whole of Borneo had been finally portioned out between the Netherlands, Sarawak, and the British North Borneo Company.

Starting out from Bandjermassin, the capital, the author's first journey took him along the east coast to the Kayan river, which he ascended as far as Kaburau—where he hoped to engage the Dyaks he wished for his New Guinea expedition—gaining his first experience of the "kihams," or violent rapids, so characteristic of the Bornean rivers, by which his boat-navigation was so often rendered difficult and dangerous. Failing in his quest, he returned to Bandjermassin and eventually to Batavia to complete his arrangements for his New Guinea trip. There it was that he was overtaken by the war-wave and compelled to forgo his project. Being on the spot, as it were, he determined to seize the opportunity to visit Central Borneo. Towards these regions he chose as his highway the Barito, the great river flowing south from the interior into the sea at Bandjermassin. This he traversed north as far as Puruk Tjahu in nearly half a degree of S. latitude, a distance to which it is more or less navigable by small steamers. Returning thence with his collections, he made a second ascent of the Barito to beyond this point. The expedition, passing the equator at Bahandang, traversed "vast jungles" and a series of great rapids—twelve in number—and eventually reached the narrow divide, 1400 feet high, which separates the Barito from the Mahakam. Crossing this, our traveller reached a short cataract-interrupted tributary of the latter river which led him into the main stream, there even in its upper reaches 50 to 60 yards wide. Four and a half months' canoeing brought the expedition safely to Samarinda at its embouchure. Thereafter an excursion to the north-east of Bandjermassin and finally one up the Katingan river to the west of the capital completed Mr. Lumholtz's Bornean adventures. As already remarked, his observations are mainly devoted to the anthropology and ethnography of the tribes visited, of whom he made acquaintance with a large number, including Kayans, Kenyahs, Murings, Penyabongs, Saputans, the nomadic Punans and Bukits, Penihings, Oma-Sulings, Long-Glats, Katingans, Duhoi (Ot-danums), and the Tamoans—none of whom, to his regret, was he able thoroughly to investigate. The observations he was able to make are none the less of very great value. A detailed report, however, is promised later on the observations made during these long and arduous journeys, and on the extensive ethnographical material collected, especially as regards decorative art and the protective wooden carvings called kapatongs—representations of good spirits (antoh) or of objects which good spirits have entered, which are always of great importance in the religious life of these tribes. The varied riverine landscapes, with their villages and inhabitants, are described in a very pleasant manner. Throughout these volumes are scattered many medical hints which will be of value to intending tropical travellers. 'Through Central Borneo' is illustrated by numerous photographs of special excellence by the author, while a sufficient map, with Mr. Lumholtz's route in red, and a good index are provided. H. O. F.

AFRICA

The Siwi Language.— W. Seymour Walker. London: Kegan Paul, Trench, Trübner & Co. 1921. 10*s*. 6*d*.

The oasis of Siwa is situated in the Libyan Desert, about 350 miles west-south-west of Cairo. It is one of the relics of a region, well watered and forested in prehistoric times, which extended west of the Nile basin (receiving

overflows of the ancient Nile) from the Cyrenaican coast to the confines of Darfur, by way of the little-known district of Kufra. Siwa was known to the ancient Egyptians as "palm land," and three or four thousand years ago the area of its plantations of date-palms was probably five times larger than to-day. It became the resort at a relatively remote period of a section of the Libyan peoples akin to the Libyans or Berbers of North Africa, and more remotely allied to the Cushitic race of North-East Africa. About a hundred years ago it was known that the Siwa ("Siwi") language was closely akin to the Berber languages or dialects of Tripoli, Tunis, Algeria, Morocco, and the Sahara desert. But until the publication of this interesting little book no full account of the Siwi speech had been given—nothing approaching a grammatical sketch, merely a few words, short vocabularies which were sufficient to establish its relationships.

It is a great pity that in preparing this work for publication the author did not make himself acquainted with the phonetic systems in vogue for transliterating unwritten tongues; even, let us say, the system long in use by the Royal Geographical Society. This may not be sufficiently elaborated for minute distinctions in sounds, but it is intelligible to those who require an approximately accurate appreciation of the main features of a language. As it is, the author seems to have gone back to the very early nineteenth century or the eighteenth for his system of transliteration. We are up against the *aa*'s, *ee*'s, *oo*'s of long ago for simple vowels like *ā*, *ī*, *ū*. The single symbol *ī* is made to stand for the diphthong *ai*. Moreover, in describing the short sound of *a* the author repeats a common mistake. This in Semitic and Libyan tongues is *not* equivalent to the English *a* as in "cat" (*æ*). It is really reproduced by the sound of *u* in "cut," "hut." The sounds *ea* (as in "pear") and *æ* (as in "bad") *do* exist in some Arabic dialects (such as Maghribi) and in Berber or Libyan, but in the Arabic they are a development of the stressed *ā*. In illustrating the stressed *ō* in Siwi (= *o* in "store") the author selects unfortunate Italian examples in which the *o* is really equivalent to the *o* in "bone." The *ō* sound is common enough in Italian (as in "hó" = "I have," "bu*o*no," "good"), but is not thus pronounced in "como," "maestro," or "cielo."

The *gh* which causes the author some perturbation is simply the Arabic غ, a velar pronunciation of *g*, exceedingly common in African, Libyan, and Semitic tongues. It is the lower equivalent to χ, which is a guttural-aspirate relative of *k*. For a variety of reasons the best transliteration of this "gh" is the Greek gamma (γ).

There is so much philological interest in this book that it is almost a pity another edition could not be printed with Siwi rendered by reasonable phonetic spelling.

H. H. JOHNSTON.

AMERICA

Through British Guiana to the Summit of Roraima.— Mrs. Cecil Clementi, M.B.E. *With* 14 *Illustrations and Map*. London: T. Fisher Unwin. [1920.]

Almost at the moment when Mrs. Clementi's book was published, the man who had the good luck in December 1884 to find the way up Roraima, till then deemed inaccessible, received a letter from America, the writer of which expressed his surprise, seemingly not untinged with regret, at the discovery recently made by him that Roraima had been ascended. He is a writer of popular books, and had been collecting material from which to write of that

unknown tableland from which, as he now discovered, the romance had been broken, like a soap-bubble, thirty-six years ago.

The American correspondent was answered that Mrs. Clementi's expected book would probably tell the story of Roraima. That, perhaps rather unreasonable, hope has not been altogether fulfilled ; and there is still room for a book in which should be brought together all that is known of that remarkable sandstone rock from the day when it was first seen by Schomburgk (the story of Sir Walter Raleigh having from a distance set eyes on it is a vain imagination) to the recent day when Mrs. Clementi, the first woman to do so, set foot on its top.

Mrs. Clementi has not added much to our knowledge of Roraima, but she has given us a very readable account of a walk through a part of the savannahs of British Guiana which, as far as is known, had never been trodden by European feet, unless indeed, centuries ago, some Dutch trader from the Essequibo or some Roman Catholic priest or Spanish trader from the Orinoco may possibly have made an unrecorded excursion into those parts.

To geographers, and to Government officials and others interested in the long overdue development of the interior of the British share of Guiana, the chief interest of the book lies in the many hints it gives as to possible ways of facilitating the entry of would-be visitors into that land of old romance and of wonderful natural scenery—thus incidentally paving the way for the development of the real riches of the country.

Perhaps the most valuable part of the book is the sketch-map, from a prismatic compass traverse by the author's husband, of the narrow belt of hitherto unexplored country through which the expedition passed ; and attention should also be called, in connection with this sketch-map, to the very illuminating diagram which is also given of the "section of country traversed between Kaietuk fall, on the Potaro river, and Mount Roraima."

It is a point of no great importance, but perhaps a mild protest may be made against the attempt made by both Mr. and Mrs. Clementi to substitute the name Kaietuk for the old-established name Kaieteur. This was an old fad of the well-known Guiana bushman the late Michael McTurk. Possibly, nay probably, the -uk termination is strictly speaking right, but the other and better known -eur will, it may be hoped, be retained. E. IM T.

Spanish America: its Romance, Reality, and Future.— C. R. Enock. 2 vols. London: Fisher Unwin. 1920. 30*s*.

South America, Past and Present.— L. C. Bollo. New York. 1919. (Translated from Spanish by N. Baros.)

The States of South America.— C. Domville-Fife. London: Bell. 1920. 15*s*.

South America and its constituent states, being of rather special interest from the point of view of modern external commercial development no less than of history, are the subjects of a large collection of descriptive works. In some—a limited number—of these geography is given its proper status ; in many it is emphatically not. But in the three works under notice, very different as they are in style, arrangement, outlook, and object, our science is not neglected, and its adaptability is very clearly illustrated.

Mr. Enock needs no introduction as a geographer. His book is intended to be "in a measure auxiliary" to those of the well-known *South American Series*, and it incorporates a number of descriptive passages from their pages. It is adequately illustrated, and its discursive interests—for it is not arranged

on severely methodical lines—fit it for the casual reader, while on the other hand no serious student of South American geography can afford to neglect Mr. Enock's work. In this book we visit with the writer first Central America, then Mexico; thence return on our tracks and proceed along the Pacific coast of the Andes; next we are in "the lands of the Spanish main," the Amazon valley, Brazil, and the lands of the Plate. We are informed now geographically, now historically, now on ethnology, economics, and the rest, and we can classify our information, if we will, with the help of an index in each volume.

Mr. Bollo limits himself to a small compass of pages. Being so limited, after an historical review, he views the continent regionally: in fact, the book is an interesting example of the regional as distinct from the political treatment, but by no means ignoring the latter, which has a chapter to itself. This is more essentially a geographical treatise than either of the others under review; it has some maps of the inartistic but informative character familiar in American publications, and it is adequately translated, but, alas! it has no index, a sad defect in a book so arranged.

In Mr. Domville-Fife's volume, which is really a complete revision of an earlier work, we find a severely practical treatment, avowedly from the commercial standpoint: of any regional survey of the continent as a whole, of any details of history, of any picturesque human touches, nothing. Nevertheless the book so far as it goes is more readily informative than the others; for any one who needs the hard facts applicable, let us say, to his business in any of the South American States this book is excellent alike in arrangement and in matter, and as it opens on each country with a notice of its topography and correlates its development with that, it forms a valuable and methodical work of reference on the several independent political divisions of South America—not, it may be observed, the colonies. It has maps and photographs.

O. J. R. H.

AUSTRALASIA AND PACIFIC ISLANDS

Stevenson's Germany: The case against Germany in the Pacific.— E. Brunsden Fletcher, Author of 'The New Pacific' and 'The Problems of the Pacific.' London: William Heinemann. 1920. *Price 12s. net.*

In so many books Robert Louis Stevenson has been shown as the central figure in the picture, with the South seas and islands as a mere background, that the main title of this the third book in which Mr. Fletcher, from the Australasian point of view, tells the history of the Pacific as a European resort, may deter the reader in quest especially of geographical information from a really interesting volume; and even the second title hardly suggests its real value, which lies in the fact that in it the writer has given not only a summary of R. L. S.'s prophetic but at the time unheeded warnings as to Germany's schemes, but, as *parergon*, has supplied clues to much that it is difficult to find elsewhere as to Germany's special methods of penetration into the Pacific. Certain sentences in the author's rather exclamatory indictment suggest at first sight that in his opinion German action in the Pacific was as atrocious as in Africa; but elsewhere he does the Germans the justice to admit that in the Pacific their conduct was nowhere as bloodthirsty as it was in Africa, for instance among the Hereros. But he holds that their Machiavellian policy of pushing in by means of trade after Englishmen and Frenchmen had done the preliminary spade-work of exploration and partial civilization, as also their treatment, by compulsory methods, of the native coloured labour, was as bad in the one place as in the other. Incidentally, however, and herein seems to lie the chief and not inconsiderable

value of his book, he indicates the sources, most of these not very well known and not easily accessible, from which he has derived the story of the establishment in 1885 of the great Hamburg trading firm of Godefroy in the Pacific, and the subsequent conversion of this firm into an Imperial affair, which was the main instrument by which "Germany in the Pacific" was created.

The more important, because least accessible, sources which Mr. Fletcher quotes in support of his "political geography" are Australasian bluebooks and Government reports in which the whole history of "the German firm" is to be discerned, somewhat obscurely it must be confessed. These prints are mainly founded on the evidence of Sterndale, Louis Becke, Trood, this last-named afterwards British Consul in Samoa, all of whom had been more or less in the service of the Godefroys—though Mr. Fletcher is probably justified in treating them as honest witnesses. Our author also refers, possibly with equally justifiable reliance, to MS. annotations, by these same witnesses, on the books in the Mitchell Library in Sydney, that most useful institution in which practically the whole literature of Australasia is shelved. E. IM T.

POLAR REGIONS

The Lands of Silence: A History of Arctic and Antarctic Exploration.— Sir Clements R. Markham. Pp. 540. Cambridge University Press. 1921. *Maps and Illustrations.* 45*s. net.*

Sir Clements Markham's earlier history of Arctic exploration, 'The Threshold of the Unknown Region,' first published in 1873, went through several editions, and is still deservedly considered as the standard English work on the Arctic. The present volume is much larger and includes both Arctic and Antarctic travels down to 1913, to the south being allocated about one-quarter of the book. It was written apparently in the years immediately preceding the author's death in 1916; and fortunately was in such an advanced state by then that very little has been needed to make the book complete. From the spirited style of parts of the Arctic narrative, however, one suspects that the account of events in the middle of the nineteenth century must have been written somewhat earlier, when the author was still in his prime.

The section dealing with the Antarctic is the less satisfactory of the two. Of 120 pages no less than 50 are devoted to Capt. Scott's expeditions. Other important explorers are treated much too briefly, particularly Wilkes, D'Urville, Bruce, and Shackleton. In the case of the two latter explorers, and indeed in the matter of all recent Antarctic work, it is clear that during the last fifteen years of his life, during which the opening up of Antarctica took place, Sir Clements was no longer prepared to appreciate what was being done, except in so far as it was the work of men with whom he was personally acquainted. As a whole, therefore, this account of Antarctic exploration cannot compare with Dr. Mill's 'Siege of the South Pole.' If disappointed, however, in not finding this a comprehensive or authoritative account of Antarctic work, readers of the book will nevertheless fully appreciate the story of Captain Scott's expeditions, so sympathetically set down here by his friend, and will read with interest of the part which the author himself played in the equipment and relief of the *Discovery*, or as he prefers to call it the Societies' Expedition. The personal nature of the book is further emphasized by the fact that the only Antarctic ship illustrated is the *Morning*, bought and despatched on behalf of the Societies by the author to relieve Scott in 1903.

Comparing the Arctic narrative with the much shorter Antarctic one, it is clear that the former is the author's real field. Sir Clements visited Baffin

Bay and Lancaster Sound in 1850–51 as a midshipman on board the *Assistance*, one of Captain Austen's searching squadron. He came back with an enthusiasm for the polar regions, which was to last over half a century, and whose effect in furthering polar exploration has been incalculable. In polar matters he soon came to occupy a position comparable only to that held by Sir John Barrow in the first half of the century. It is impossible, therefore, not to compare the two: both while still young wrote histories of Arctic travel expressly to stimulate public interest, Barrow in 1818, Markham in 1873; and both in later life were able to write a second volume embodying the results of the Arctic explorations which they themselves by work at home had so largely helped to success. Barrow's vigorous attack on Sir John Ross is still remembered; Sir Clements in the present book is just as outspoken in his likes and dislikes, and never leaves any doubt as to who is to have the praise and who the blame. This feature, together with numerous personal notes on the later careers of naval "Arctics," gives the book its character and interest. At the same time it must be admitted that it is not so much an impartial history of Arctic exploration, as the impressions and judgments of one who knew most of the leading actors personally.

The early chapters were necessary for completeness, but compared with what follows they seem to lack life. With each succeeding chapter, however, the author's interest increases, culminating in the nineteenth century. The chapters dealing with the period from Ross's voyage in 1818 down to Nares' in 1875–76 are without doubt the most interesting of the whole book. They deal with the people whom the author actually knew.

A few of Sir Clements' opinions may be quoted. Baffin and Davis are undoubtedly his favourites among the earlier voyagers: Bylot, however, he can never excuse for deserting Hudson. Belcher is condemned in the strongest terms: on the other hand, Sir John Ross is exonerated. As to the North Pole controversy: Sir Clements seems to think that Dr. Cook's was a much finer journey than is generally believed, and that Peary no less than Cook was in error in believing that he had actually reached the Pole.

The illustrations are not very well selected. This may perhaps be set right in a later edition; and certainly an entirely new set of maps will have to be provided. Ravenstein's excellent maps were a feature of 'The Threshold of the Unknown Region.' In the present volume the map given of the Arctic has been out of date several years; there is no map of the Antarctic; and no satisfactory map of Arctic Canada to illustrate the Franklin search. The poorness of the maps is a distinct blemish on the most interesting account of Arctic exploration written in our time. J. M. W.

THE MONTHLY RECORD

EUROPE

Distribution of Population in Sicily.

A CAREFUL study of the distribution of population in Sicily, on the lines of one previously undertaken by Dainelli for Tuscany, has been brought out by Prof. A. Mori as No. 36 of the *Memorie Geografiche* issued as a supplement to the *Rivista Geografica Italiana* (Florence, 1920). The social and economic problems connected with such a study are unusually important in the case of Sicily, owing to the extraordinary variations of density from one part of the

island to another, and it is particularly interesting therefore to correlate such variations with the topography and other geographical factors. Prof. Mori considers the subject from diverse points of view, and the labour involved in the collection of the data, and their handling so as to bring out the lessons to be learnt in the most instructive way must have been very great. The text describes the methods employed, and discusses in detail the facts of the distribution, paying attention not only to present-day conditions, but to historic changes; while a series of maps on the uniform scale of 1 : 800,000 supplies an excellent graphic representation of the facts. The first of these has been compiled, in the usual way, on the basis of communes as units, but in view of the very varying size of these the result is not altogether satisfying. Prof. Mori has therefore constructed a second, in which curves of equal density are drawn according to a method used some years ago by O. Marinelli. Both maps bring out the fact that the greatest density occurs in the environs of Palermo, the eastern slopes and coastal zone of Etna, and the extreme north-east, but it is only the second which shows the density on the slopes of Etna as decreasing from the coast upwards, this being masked in the other by the fact that some of the communes run upwards to the summit. The density of the whole island is 144 per square kilometre—greater than that of Italy as a whole—but there are considerable stretches of the coast with an average density of over 500. The difference between individual communes is very great, owing to the great differences in area, and according to the presence or absence of urban centres. One of the most marked characteristics of Sicily is the concentration of population into such urban centres, and the extreme sparsity of the population of wide intervening tracts. In order the better to bring out the distribution of the scattered population, one of the maps shows this alone by gradation of shading, while the position and size of the centres of habitation are shown by a series of symbols. In the whole province of Girgenti the scattered population amounts to only 4 per cent. of the total. Prof. Mori gives particular attention to the altimetric distribution, and also to the effect of the distance from the sea. In the north and east the density decreases in general with altitude and distance; but on the south-western versant the population tends to be aggregated at some distance inland. As has been observed elsewhere, there is often a certain diminution with altitude, followed by a distinct increase again at higher levels. The population of the island has fluctuated enormously within historic times. From a possible four millions in early Greek times it fell to perhaps little more than half a million at the beginning of the sixteenth century, since which it has gradually recovered to its present total of something like four millions. Associated with this fluctuation is the large number of centres—157 out of a total of 361 communes—which have come into being only within the last four centuries. This is the subject of a supplementary article by Prof. Mori in the *Rivista Geogr. Italiana*, Settembre–Dicembre 1920, which shows how the new centres have not been evolved by a natural process, but were founded of set purpose for the colonization of lands that had become derelict.

AFRICA

French Exploration in the Western Sahara.

A long-cherished ambition of the French in the Sahara—to effect a junction between Algeria and Mauretania in the same way in which a junction between Algeria and the Western Sudan was brought about some years ago by Colonel Laperrine and his coadjutors—was successfully realized during December of last year. Early in January came the news from Senegal that two columns, the one

starting from Algeria under Captain Augiéras, the other from Mauretania under Major Lauzanne, had met before the end of the year at a spot arranged in the very centre of the least known part of the Western Sahara, lying south of Marocco and known at first hand only from the journeys of Caillié and Lenz. Captain Augiéras, whose valuable memoir on the Western Sahara was reviewed in the *Journal* for February last, had already done much to improve our knowledge of this region by his network of routes, from 1913 to 1917, to the west and south-west of Twat, so that the route to be followed by his column was to some extent over known ground. His party included three other French officers and 150 "Meharists" (camel-riders). Starting on December 1 from Tab-el-bala in about 29° N. and nearly due south of the Marocco–Algerian frontier, he had to proceed slightly south of south-west to reach the proposed rendezvous of El Mzereb, situated a little north of 24° in about 6° W. of Greenwich. This is one of a series of watering-places which line the course of the Hank, or escarpment by which the broken plateau in the centre of the Western Sahara, already explored by Captain Augiéras, falls north-west to the region of sand-dunes of the Igidi. According to the preliminary accounts of the journey the route seems to have led for the most part across the Igidi, possibly traversing some of the higher ground before reaching the rendezvous. The other column started from Atar in the Western Adrar, and, passing through Rhallawia, proceeded north-east through nearly unknown country, apparently striking the Hank near its south-west end and following it to the north-east with the help of the line of watering-places already mentioned. The two columns met at El Mzereb on Christmas Day, that from Algeria being escorted on the final stage by a party sent to meet it by Major Lauzanne. Both columns were at Atar by January 19, Captain Augiéras then continuing his journey to the south-west through the dune-belt of Waran, the Tagant plateau, and the Brakna plain, reaching Dakar on April 5 and so completing a journey of 4500 kilom. He has since returned to Paris, and fuller accounts of his experiences may therefore be expected shortly. Whilst previous routes across the Western Sahara have crossed it in an approximately north and south direction, the recent traverse has been in a diagonal direction from north-east to south-west, and geographical results of considerable value are said to have been gained. The general direction of the reconnaissances can be followed on the map accompanying Captain Augiéras' former memoir.

AMERICA

Dr. O. Nordenskjöld's Expedition to Patagonia.

Some account was given in the *Journal* for February of this year (p. 149) of the research expedition to the Andean region undertaken by the Swedish explorer, Dr. Otto Nordenskjöld. He had then completed the first part of his programme—reconnaissances in the Andes of Peru—and had gone south to begin work in the mountains of Southern Chile, with a special view to glaciological observations. This part of the enterprise has also been successfully accomplished, and Dr. Nordenskjöld has returned to Europe with a rich harvest of results. We have received through a Fellow of the Society, Mr. Leonard Cooper, M.INST.C.E., cuttings from the Buenos Aires newspapers *La Nacion* and *La Prensa*, giving some details about the expedition which had been communicated by the explorer during his stay at that city whilst on the way home. Dr. Nordenskjöld and his colleagues established themselves at Kelly inlet, on the shores of the Gulf of Penas, in 47° S. lat., and thence made various excursions inland for the study of the glaciers. The cold, constant rain, and absence of inhabitants proved serious obstacles, and Dr. Norden-

skjöld thinks that exploration from the Argentine side of the mountains might offer fewer difficulties. Only at wide intervals were natives met with, probably of Araucanian stock. During the two months' stay, however, a good deal of country was mapped, and besides the glaciological observations studies were made of the flora and fauna, which are likely to yield interesting conclusions.

AUSTRALASIA AND PACIFIC ISLANDS

Flora of the Summit-plateaux of Tasmania.

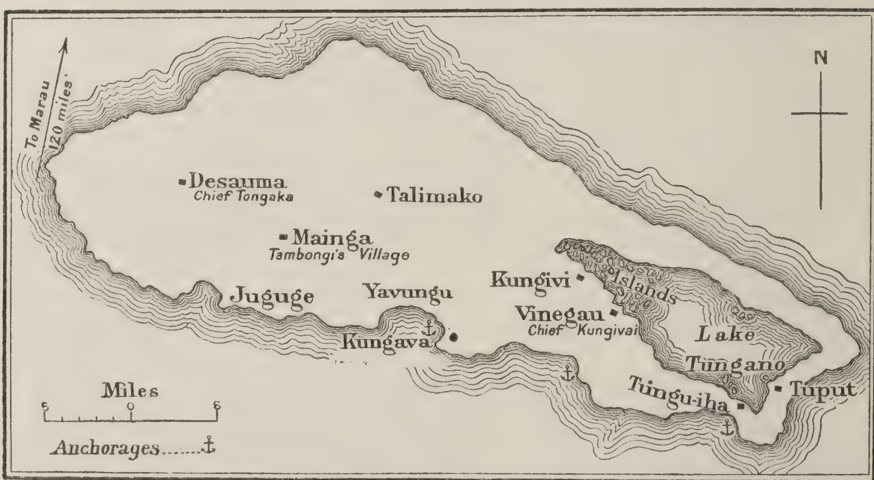
A further study of vegetation in the Australasian region has been contributed to the *Journal of Ecology* (Vol. 8, 1920, Nos. 1 and 2) by Miss L. S. Gibbs, in a paper entitled 'Notes on the phytogeography and flora of the Mountain Summit-plateaux of Tasmania.' The paper includes detailed descriptions of the collections of plants made by the author, but we are here concerned only with the general discussion of the plant formations and their relations to geological, geographical, and climatic conditions. After separation from Australia in late Quaternary times, Tasmania was subjected to glacial conditions, with little or no vegetation but moss and low shrubs. The country was formerly one huge plateau formed of horizontal lava-flows, the present features being due to subsequent glacial and sub-aerial denudation, which have broken down the greenstone into steps or left portions as isolated groups of high tablelands, the whole distinctly reminiscent of Iceland. The so-called "Central Lake Plateau," with a height of from 2500 to 3300 feet, is flanked by mountain summit-plateaux rising to 5000 feet, while the west coast is composed of pre-Cambrian schists, gneisses, granite, etc., in rugged mountain masses not rising above 4500 feet. This western region has a very heavy rainfall of over 150 inches. Judging by mean temperature only the climate is temperate, but the plant-covering is chiefly affected by the cool summer and constant storms. It is generally uniform, but may be classified as (1) The Austral-montane flora of the summit-plateaux; (2) Mixed forest of the west coast; (3) Eucalyptus formation of Australian type. That this last is comparatively recent is proved by the absence of a single endemic genus, and its exotic character is also shown by the liability of the forests to be killed by severe frost. The first-named formation—the principal subject of the study—is divided by Miss Gibbs into open and forest associations, the former largely consisting of mountain shrubbery, the latter of dwarf or low mountain forest with some small *Eucalyptus* scrub. The herbaceous subdivision of the open associations includes a remarkable form, found on the most exposed levels, described as "plant-mosaic." After the late melting of the snow, a level covering of small moss-like plants is developed, the different shades of foliage blending and contrasting, and strongly suggesting a mosaic pavement. Although moss-like in appearance it is quite hard to walk on. This must have been the chief plant-covering of the ancient plateau, being gradually succeeded by the mountain shrubbery as the rocks became weathered so as to afford root-hold for larger plants. In the shrubberies no one plant predominates, and instead of the wide colour effect of a single species, the various colours—white to yellow and pink—are evenly distributed as over a carpet. The dwarf mountain forest was seen at its best on the summit-plateau of Mount Field, where all the usual species of the mixed forest occurred in much dwarfed form, about 10 feet high.

The flora in question belongs to a group occurring throughout the sub-antarctic zone under special conditions in widely separated localities. Requiring low temperature, intense illumination, and heavy rainfall for their development, the plants are limited to altitudes above tree-level in normally

forest-clad regions, but find the needed conditions at sea-level in the Antarctic. In the absence of an annual leaf-fall there is no progressive improvement in soil conditions, whilst leguminous plants as nitrifying agents are also wanting, so that herbaceous plants are but sparsely represented. The origin of this scattered Austral-montane flora has long been a subject of speculation, but as it is now practically certain that the various land masses have not been united since the Tertiary period, the wild west winds, the potency of whose agency was long ago recognized by Hooker, must be regarded as the one effective means of transport from one locality to another within the zone in question, while the persistent pole-ward upper current, which blows steadily from north-west to south-east from India over New Guinea and Australia to New Zealand and beyond, may equally account for the distinct Himalayan and Papuan elements in the Austral–Antarctic flora.

Rennell Island.

Probably the least-visited island in the whole Pacific is that known as Rennell, which, with the smaller island of Bellona to the west, lies some 120 miles south of Guadalcanar in the Solomon group. Although almost on the track of steamers, they have remained in virtual isolation on account of the absence of good anchorage, as also of any product of commercial value. Rennell is almost entirely surrounded by walls of coral limestone, 300 feet high in places, cutting off the inhabitants, who speak a hitherto unstudied dialect, from easy intercourse with the outside world. We have received an account of the island from Dr. Northcote Deck, a missionary at Aola in Guadalcanar,



Rennell Island.

based upon a series of visits made by him between 1908 and 1911, which for the first time supplies detailed information on the island and its primitive inhabitants. On the first visit a landing was effected in a sheltered bay on the south coast near the western end of the island, although the depth of water near the shore made anchoring impossible, and the interior plateau or basin was reached by climbing up a crevice in the forest-clad coral cliffs. After a tramp through the evergreen forest in torrents of rain, a single native house was reached, and relations established with the natives, who though heavily armed were quite friendly. They brought every available object for sale, to

obtain the much-coveted iron. All were smeared with turmeric, giving them a bright yellow colour, and were tatooed in regular patterns according to rank. Their peculiar pungent odour was very noticeable. One of them came away in the schooner, but became at once so strongly affected with nostalgia as to be a constant anxiety until taken back five months later. On this second occasion anchorage was found in a deep bay on the south shore, further east than the first landing-place, at a spot known as Kungava, where natives were once more met with. A visit to the interior was again made, by climbing the coral rampart. The track led gently downhill, bearing out the theory that the whole island had once been a gigantic atoll like Leuanina, or even consisted of a wide encircling reef like the Indispensable, 50 miles to the south. The coral was fissured in all directions, the interstices partly filled with red soil, said to be of volcanic origin. Caves were seen, swarming with flying foxes, whose teeth seem to form the only currency on the island. Ten miles of winding track brought the party to the shores of a fine inland lake, 10 miles long, with islands dotted over its western end. It is entirely separated from the sea on all sides, but must communicate by fissures in the coral, as its water was too salt to be drinkable by the visitors (though used for drinking by the natives), and it was subject to a tide of a few inches, once in the day only. The lake is navigated by means of great unwieldy canoes provided with masts and resembling floating platforms. In one of these a native village was reached, where the party again met with an eager welcome. Here they encountered the most important chief of the whole island, who arrived with a small fleet of canoes from the largest village, Vinegau. He was a dignified, powerfully built man, 6 feet high and broad in proportion. His village was visited on a subsequent occasion, and the lake crossed to the north side, where the neck of land was barely 2 miles wide. An attempt to sound the lake gave a depth of 7 fathoms near the western end, but elsewhere no bottom was found with 30 fathoms of line, and Dr. Deck regards it as the crater of a volcanic peak round which the island has been formed.

The population of Rennell is put down as not exceeding 500, the largest village consisting of only eight houses. The people usually live very much scattered, for though 100 congregated at the shore at the first landing-place only a solitary house was seen in that part of the island. Few have ever left for the Queensland plantations, and none who went ever returned, so no English is spoken. The climate is evidently mild, for none of the houses had walls to keep out the weather, though the rainfall seems to be heavy. Few groves of coco-nuts were seen, and the gardens were small and poor: apparently the bush has to be cleared solely by burning. The people still possess little iron, and appear in fact to be still living before the Stone age, the only implements or weapons of stone seen being two stone maces, symmetrically ground with eight knobs, bound to a handle with sennit, and seemingly for ceremonial use (one of these is now in the British Museum). There is a similar absence of stone implements in the Solomons, but this is explained by the time which has elapsed since the natives first obtained iron. In Rennell practically no stone but the coral exists, only one black boulder having been seen on the whole island. The islanders are true Polynesians in being great fighters and wrestlers, evidently (unlike the Melanesians) loving personal combat. The men have very powerful frames, though as a rule of no great height; in wrestling they could always throw any of the Malaita men. Their most striking weapons are thrusting spears of hard black wood, about 12 feet long and six pounds in weight, with fifteen to twenty barbs on each side, cut out of the solid.

The making of them would seem to be a lost art. Throwing spears are also used, with points made of human leg and arm bones, and tipped with a bone splinter designed to break off in the wound. Bows and bone-tipped arrows were in abundance, whereas the usual Polynesians disdain shooting from a distance. Although mostly friendly, the people are great thieves and murdered three native teachers left with them, apparently for the sake of their goods. They cut out the long bones of the legs and arms, but did not eat the bodies. They seemed to feel keenly the monotony of isolation, and showed a settled melancholy both in their faces and the cadence of their voices. Their only sort of music, to which they dance as it were in monotone, consists in the tuneless beating of a log. It is questionable whether intercourse with the outside world would be a blessing to them. Malaria seems to have been unknown in the past, but in spite of all precautions to have been introduced temporarily by a party of five that had been taken to Malaita. No species of anopheline mosquito could however be found.

Bligh's Journal of his Second Voyage.

In the review, in the April number (p. 303), of Mrs. Marriott's recent book on the above voyage, it is stated, as it is also in the book itself, that Bligh's Journal is preserved at the Admiralty. This was the fact at the time when the book was written, but Mr. R. L. Atkinson of the Public Record Office writes to point out that it is so no longer, since Bligh's Journals have since been transferred to their proper place in the Record Office, where they now form vols. 151 to 153 in 'Ships' Logs, Series II.' For some reason or other the log in question was retained at the Admiralty when others of that date were transferred, according to the usual practice, to the Record Office. In 1876 Bligh's logs were lent to the Science Museum at South Kensington for exhibition, and remained there till 1912, when they were temporarily retransferred to the Admiralty after having been brought to the notice of the Admiralty Librarian through Dr. Corney—the writer, as it happens, of the review of Mrs. Marriott's book. It was the publication of this book which once more called attention to them and led to their deposit at the Record Office early in the present year.

OBITUARY

Lieut.-Colonel Sir James Robert Dunlop Smith, K.C.S.I., K.C.V.O., C.I.E.

Sir James Dunlop Smith was suddenly stricken down with tuberculosis last summer, and had immediately to leave his post as Political A.D.C. to the Secretary of State for India in order to undergo special treatment in Scotland. From the first he meant to put up a strong fight for life, and his firm courage sustained him for a while till there seemed a prospect of his recovery. But he took a sudden turn for the worse and died of heart failure on April 24 at the age of sixty-two.

Sir James was no great geographer; he had made no great journey nor carried out any great scientific work. But he was a great Fellow of our Society. He loved his fellow-men. And his long years in India had brought him in contact with many travellers. So he inevitably was drawn to our Society, and his fellowship with it was of the closest and warmest. As member of Council and afterwards as Vice-President he entered whole-heartedly into our affairs, and

with his usual thoroughness was always willing and ready to help wherever his experience could assist us.

It was this same attachment to his fellow-men and his conscientiousness in affairs which had rendered his career in India and at the India Office so successful. Indians and British alike could feel that he started anxious to be on good terms with them and anxious to help them, and that if he did help them he would help them thoroughly. He was dependable, and he was affectionate; and the loss of one with so strong a sense of fellowship our Society has the strongest reason to deplore. F. E. Y.

Captain S. C. Plant.

News has been received from China of the death at sea, in February 1921, of Captain S. C. Plant, whose name has long been a household word to all interested in the opening of the Upper Yangtse to trade and navigation. It is well known what an obstacle to navigation is caused by the gorges and furious rapids which obstruct the river during its passage through the mountainous belt above Ichang, and which long made communication with the upper river possible only by the slow and laborious method of "tracking"—the towing of native vessels from the banks by long strings of men. When, mainly owing to the efforts of the late Mr. Archibald Little, it was at last decided to attempt the passage of the rapids by a steamer, the *Pioneer*, the command was given to Captain Plant, who had previously had special experience of river navigation on the Euphrates. The attempt succeeded, and though for some years the difficulties proved too formidable to permit the opening of regular navigation, the measure of success attained encouraged the expectation—now realized for a good many years—that the formidable barrier would at last yield to further effort. Captain Plant continued to give his services to the cause, year by year adding to his knowledge of the rapids, and in 1913 was appointed by the Chinese Government to the newly created post of River Inspector for the Upper Yangtse.* He was the author of a 'Guide to Shipmasters and Pilots on the Upper Yangtse,' and only this year published at Shanghai a small volume descriptive of the rapids and their navigation, illustrated by a striking series of photographs and pen-and-ink drawings by Mr. I. A. Donnelly ('Glimpses of the Yangtse Gorges.' Shanghai: Kelly & Welsh). At the time of his death he had just started home on leave, succumbing to pneumonia only the day after sailing from Shanghai.

CORRESPONDENCE

International Aeronautical Maps.

It is only this morning that I have had the opportunity of reading Colonel Lees' interesting lecture on Aeronautical Maps, which I was unfortunately prevented from attending. I am surprised to see that apparently no British Air Officer contributed to the discussion. The subject is of great interest, and I feel that some independent opinion from the aviation point of view should be put forward.

* Captain Plant's services to Yangtse navigation are summarized in an article by Captain P. A. Lapicque in the *Bulletin Econ. de l'Indo-Chine* for 1917 (see *Journal*, vol. 50, p. 459).

Dealing first with the three controversial points enumerated by Colonel Lees:

1. *Mercator's Projection.* I am not a navigator, but I have had a great deal to do with maps and map-reading all my life; I confess that I have a rooted objection to the use of Mercator's Projection for air work. The speed of aircraft is so great and their range of vision so wide that as aerial transport extends its activities over the world, the general map will be far more frequently employed than the local one. Even on this small scale I consider that any distorted representation of the Earth's surface is most undesirable from the aviator's point of view. We must remember that an aerial navigator in the true sense of the term does not exist to-day; no living man has sufficient experience to claim such a qualification. I think I am right in saying that the airmen who demand the Mercator's Projection are all men trained on strictly naval lines. The present system of naval navigation is based on the fact that the sailor cannot see any of the natural features of the Earth; such a system cannot be suited to a pilot who can see literally hundreds of square miles of the Earth's surface at one moment.

No body of expert opinion exists to contradict the naturally conservative ideas of men trained to navigate the sea; the average pilot, no matter how brilliant a flyer he may be, has only the foggiest knowledge of navigation, and can voice no useful opinion.

Colonel Jack says that flying in the Polar Regions is not likely to be very common, and he therefore does not think the extreme distortion in the north any serious disadvantage. Don't be too sure; the Arctic circle offers a most attractive and economical aerial course for lighter than air craft at certain seasons of the year. No, I view with apprehension the apparently hasty decision of the Convention to adopt Mercator's Projection. I am not sufficiently expert to say what system should be used, but no matter how small the scale, no serious distortion of the Earth's surface should be involved.

2. I am on the whole in favour of hill-shading; not because I think the local map should be the complement of the general map, but because the shading method tells a pilot what he wants to know more quickly and more reliably. For plotting out a course before the start, shading seems to have all the advantages of the layer system, except that the line ruled to show the course is a little harder to see. In the air, the following is the class of problem which presents itself to the comparatively small type of heavier than air craft. Let us say that an aeroplane is flying south under the clouds, which are at 3000 feet, with a view to crossing the Pyrenees. As the mountains are approached it becomes obvious that the clouds will be down on all the higher ridges. The pilot now has to make up his mind: (1) how high he has to climb to clear the highest points; (2) at what point of his course he must start climbing through the clouds; and (3) for how long after that point he must fly before coming down out of the clouds. This problem, I think, can be most readily solved on a shaded map marked with the heights not only of the highest points but of the largest projecting spurs, and this, to my mind, applies to general maps as well as the local.

3. The proposal to show railways in red and roads in burnt sienna appears quite sound. I see that Captain Lloyd suggested exaggerating the main features of towns; once more I am all against any form of distortion.

Finally, I trust that a judicious selection will be made of the areas to be produced first. For instance, the provision of maps for these islands would, in my opinion, be waste of time and money at the present juncture; the

existing Ordnance Survey is quite good enough for any one, and an aeronautical map would be an unjustifiable luxury. Let us start on localities of which the maps are poor and which offer prospects of regular aerial traffic in the future. Calcutta to Rangoon and Singapore; Aden to Mombasa; Khartoum to Nairobi; and similar links, spring to the mind as the most useful field for our first efforts.

W. S. BRANCKER,
Major-General R.A.F. (Retired).

2, Dorset Street, London, W.1,
9 May 1921.

The Circulation of the Earth's Crust.

May I be allowed a word of comment on the subject of Colonel Tandy's paper in the May number, at the reading of which I could not be present?

The paper dealt mainly in generalizations, and I would suggest that the validity of the theory might be tested by looking at the actual facts of erosion and deposition in an area easy of study like the English Lake District. I select this as an area of marked relief within small compass, and one with which I am more intimately acquainted than perhaps any other of like extent. As assistant to Dr. Mill in his survey of the under-water contours of the lakes in 1893–94, my attention was naturally called to the problem of the origin of the heights and hollows, and in the discussion after Dr. Mill's paper I ventured to draw some conclusions—arrived at independently, but in accord, I believe, with those of other observers.* In trying to account for the fact that the deepest hollows seemed generally associated with the greatest heights, it occurred to me for a moment that the matter from beneath the hollows had, as I then expressed it, "gone to make the mountains" (by a somewhat similar process to that supposed by Colonel Tandy). But an examination of the facts showed that the idea did not square at all with these. The deepest hollows seemed everywhere to be portions less subject to deposition, while the shallower parts were everywhere associated with areas of degradation, the products of which had been transported into the original basins. The steepness with which the deltas of the main feeders fall to the depths has struck all observers, large masses of shingle and even blocks of some size being pushed out by the current and resting at the edge at an angle even steeper than that at which such *débris* rest above water, *e.g.* on the spoil-heaps of quarries. The forward advance of such deltas is very noticeable, even within a limited period, and in some cases (*e.g.* in Haweswater) bids fair to divide the lake into two basins, a stage which has been reached in the case of Buttermere and Crummock, Derwentwater and Bassenthwaite, respectively. Surely all this is directly opposed to Colonel Tandy's theory. Why, *e.g.*, should such deltas persist at all, instead of being engulfed in the subjacent rocks?

Dr. Evans has already criticized the main idea of the paper on the ground that it would furnish a case of perpetual motion. However this may be, it would seem at least to introduce a new principle—multiplication, in place of conservation, of energy. Is there not some similarity between the ideas put forward and those of a would-be inventor who should propose to use the heat generated by a continuous brake to accelerate the motion of the train? He too might meet objections by saying that he was not pretending to create new force, but merely to draw upon that supplied by the combustion of the coal.

* See *Journal*, vol. 6, p. 165. Mr. J. Y. Buchanan afterwards told me that he had arrived at similar conclusions in regard to the Scottish Lochs.

The question also suggests itself whether, if the principle of circulation is of such minute and general application as Colonel Tandy supposes, we should not be able to detect its effects almost everywhere in the distortion of strata where, as in mines, their present position can be actually traced underground. Should we, for example, find a seam of coal preserving a regular course for any distance anywhere? EDWARD HEAWOOD.

MEETINGS: ROYAL GEOGRAPHICAL SOCIETY: SESSION 1920–1921

Thirteenth Evening Meeting, 2 May 1921.—The President in the Chair.

ELECTIONS.—Herbert Arthur Baker; Miss Hilda Ann Hippisley Barnes; Reginald Bezzant; Albert Francis Barclay Bridges; John S. Burns; George Edward Nicholas Cheke; Lieut.-Col. Gerald Dalby, D.S.O.; Lawrence Thornewaite Grace, M.C., A.M.I.C.E.; Major W. G. G. Grant, M.C.; Captain George M. Harding; Commr. Richard Harrison, D.S.O., R.D., R.N.R.; Horace A. Hawkins; John Richard Hobhouse; Arthur L. Humphreys; Reginald John Kiker, D.D., LL.D.; Arthur T. Loyd; Henry Walter Maclean, C.M.G.; Al-Haj Massequoi; Captain Frederick Samuel Mateer, R.F.A.; Claude E. Matthews; Henry Leslie Morgan; The Rev. Thomas Paxton; Sir Charles Ross; T. H. Seaver; Thomas Shenton Whitelegge Thomas, O.B.E.; Joseph Edward Thornton; Henry Buswell Wetherell, M.A.

PAPER: Travels in Turkestan, 1918–1920. Captain L. V. S. Blacker.

Fourteenth Evening Meeting, 23 May 1921.—The President in the Chair.

ELECTIONS.—E. W. Barron; William Bensley Cotton; George Ashmore Fitch, B.SC.; Leopold A. Flint; Ralph A. Graves; Ahmed Hassanein Bey; George W. Johnson; Lieut. J. O. Lawson; Captain Robert Logan; Monsieur Hubert de Monbrison; Captain Donald C. Mudie, R.F.A.; Lieut.-Col. Cecil Rae; Dr. Alfred L. Sachs, M.A.; Lieut. A. R. W. Sayle, R.N.R.; Harold Schofield; Laurence Dudley Stamp; Mrs. Margaret Sully; Miss Mary Kathleen Langdon Thomas; Nicholas Tombazi; Miss Dorothy Wilford; Hubert Worsley Woolley, M.C., B.A.; Frederick R. Wulsin.

PAPER: Across the Libyan Desert to Kufara. Mrs. Rosita Forbes.

Seventh Afternoon Meeting, 9 May 1921.—The President in the Chair.

PAPER: On the Origin of Mountain Ranges. Col. Sir Sidney Burrard.

INDEX

* Denotes Articles and Papers. § Reviews and Notices.

D.

E.

T.

INDEX TO MAPS

EUROPE.

ASIA.

AFRICA.

NORTH AMERICA.

POLAR REGIONS.

GENERAL.

ILLUSTRATIONS AND DIAGRAMS

EUROPE.

ASIA.

AFRICA.

NORTH AMERICA.

GENERAL.

END OF VOL LVII.

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ROYAL GEOGRAPHICAL SOCIETY

NOTICES

MEETINGS in the **ÆOLIAN HALL**, 135 New Bond Street, W.1, at **EIGHT-THIRTY** p.m.

Monday, June 6. Journeys in Kam . . . . Eric Teichman.

,, ,, 20. The Egyptian Wilderness . . Dr. W. F. Hume.

(*Last Meeting of Session.*)

PHOTOGRAPH ROOM. The attention of Fellows is called to an Exhibition of photographs of the Himalaya by Mr. C. F. Meade, Mr. Nicholas Tombazi, and others, which will be shown in the Photograph Room early in June. All photographs which arrive from the Mount Everest Expedition will be shown in this room during the summer and autumn.

THE SOCIETY'S HOUSE. The House is open on week-days from 10 a.m. to 6 p.m., except Saturdays, when it closes at 1 p.m.

By Order of the Council,

ARTHUR R. HINKS,

Secretary.

Royal Geographical Society.

Kensington Gore, London, S.W. 7.

The object of the Society being the Promotion and Diffusion of Geographical Knowledge, it has always welcomed to its Fellowship those anxious to further this object by their interest and support, as well as those able to take a more active part in the work of discovery and exploration.

Candidates for admission into the Society must be proposed and seconded by Fellows, and it is necessary that the description and residence of such Candidates should be clearly stated on their Certificates. Forms of Certificates and Pamphlet of Foundation, History, and work of the Society, Charter and Bye-Laws can be obtained on application to the Secretary.

It is provided by Chapter V., § 1, of the Bye-Laws, that—

"Every Fellow shall, on election, be required to pay £5 as entrance fee, and £3 as annual subscription "for the current year, and thereafter a yearly contribution of £3, due on the 1st January of each year; or he "may compound either at entrance by one payment of £45, or at any subsequent period on the following "scale, provided that there shall be at the time no arrears due by him to the Society:—

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15 ,, ,, ,, 20	£24
20 ,, ,, and over	£18 15*s.*

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The privileges of a Fellow include admission (with one Friend) to all ordinary Meetings of the Society, and the use of the Society's House, Library and Map-room. Each Fellow is also entitled to receive a copy of all the Society's Periodical Publications.

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